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Copies of the Year Book, Regulations, and Candidates' Certificates may be had on application at the Society's House, 1, Savile Row, London, W.

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EXTRACT

From the President's Address,

May, 1910.

At our last annual meeting the question of the accommodation provided at Savile Row was dealt with at length, and it was pointed out that our existing house did not adequately meet the needs of a rapidly growing Society. Since that date the adjoining property, No. 6A Vigo Street, has been bought by the Society at a total cost of some £14,000.

These premises could be utilized with great advantage two or three years hence, when certain leases fall in, and here is an obvious method of making the Society more useful to its Fellows. The only difficulty involved is that of finance. The appeal issued to the Fellows for subscriptions to a Building Fund resulted in the receipt of donations to the amount of about £2800. Moreover, the sum of £1423, set aside from the general income of the Society, and one legacy* amounting to £1000 have also been credited to that Fund. Thus the total sum available in the Building Fund is now only £5223, and it has been necessary to sell out stock to the value of about £4000 to partially cover the cost of purchasing the new premises, leaving a deficit of over £4000. But if the present income of the Society were diminished, the work of the Society would have to be curtailed, and its usefulness diminished. It follows, therefore, that unless further donations or legacies are received, which would not only make up for the loss of income resulting from this sale of stock, but would also cover the cost of incorporating the new premises as a part of our house, it would be unwise to face the loss of rent due to that incorporation for many years to come, and the enlargement of our house would have to be indefinitely postponed. I must, therefore, once again remind the Fellows of the advantages which will accrue to the Society from any generous contribution they may be willing to make to the Building Fund. Every gift will hasten the date when that much-to-be-desired incorporation will become possible. It is hoped, at all events, that further subscriptions will be received by which the existing deficit of about £4000 may be wiped out without having to sell out more stock. One generous Fellow of the Society has indeed already promised £500, a sum to be increased to £1000 if sufficient funds should be raised to incorporate in a new building a Memorial Hall in which to record the names of great explorers. May I also remind those Fellows elected before 1908 that the annual subscription is now raised to £3 3*s*., and that if they all would also voluntarily undertake to pay this same subscription for five years, this debt would be far more than wiped out.

* £1000 from the late Miss Wolff.

Royal Geographical Society

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The following is a statement of the Subscriptions and legacies appropriated to the Building Fund up to date, June 15, 1910 :—

	£	s.	d.
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The Geographical Journal.

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A SIXTH JOURNEY IN PERSIA.*

(*a*) A TOUR IN ANCIENT PARTHIA.
(*b*) NISHAPUR AND TURSHIZ.

By Major P. M. SYKES, C.M.G., Gold Medallist of the Royal Geographical Society.

PARTHIA and the problems connected with it have strongly attracted me since I first travelled up the river Atrak in 1893. Consequently, when, in the autumn of 1908, I was permitted to tour down the Gurgán valley, I was able to carry out a long-cherished plan of acquainting myself more thoroughly with a part of Persia which yields to none in interest. Before, however, describing my journey it seems desirable to outline briefly where the province of Parthia lay, before it rose from obscurity to become an empire powerful enough to challenge with success the might of Rome. Taking Canon Rawlinson as our guide, we learn that the eastern boundary of Parthia was that of modern Khorásán, namely the Tajand river; and that thence it ran west on both sides of the great range known as Elburz to the ancient world, until it reached the province of Hyrcania, which was the belt of country on the eastern shore of the Caspian sea, at its southern end. The exact boundary between Hyrcania and Parthia does not appear to be known with any exactitude; and, indeed, in the earliest notice of the Parthians as a people in the great inscription of Darius at Behistun, the Parthwa and Varkana are coupled together, Varkana and Hyrcania being the same word, which is preserved in the modern Gurgán.

Our route ran from Meshed north-west to the famous turquoise mines and so north to Bujnurd. From that Kurdish district we travelled west down the Gurgán valley to Astrábád, which was undoubtedly in ancient Hyrcania. The return journey lay across the Elburz to Shahrud and

* Read at the Royal Geographical Society, November 7, 1910. Map, p. 128.

thence east along the southern slopes of the range *viâ* Sabzawar and Nishapur, back to my headquarters. Taken in connection with my previous journey of 1893, and subsequent tours, it will be seen that I have been fortunate enough to have visited almost every part of this ancient kingdom.

Our party, which included Major Watson, to whom I owe most of the photographs, and who also is the authority for any notes on birds, left Meshed at the end of October for the Ulang-i-Shâhi, or "Royal Meadow" some 50 miles north-west of Meshed. This is one of the famous grazing-grounds of Central Asia and extends in a narrow strip for many miles down both sides of the Kashaf Rud, which rises close by. In the days when Persia was ruled by nomad sovereigns, the "Meadow" and adjacent town of Radkán were favourite summer resorts of the great Khans. Legend connects the name of Sultán Sanjár with Radkán, which was apparently the birthplace of the Nizam-ul-Mulk, his famous Vizier; but we are on firmer ground in stating that Shaybani Khan, the last of the conquering Uzbegs —the Amirs of Bokhara are his lineal descendants—spent many summers in the neighbourhood and laid out a garden, the name of which is perpetuated in Gokbagh, or "Blue Garden," where we camped. The marshy ground along the river was full of duck and snipe; but as we marched the next day to Seüdábád, some 10 miles north of Chinárán, we were only able to spend a few hours shooting. It was, however, for its breed of horses that this grazing-ground was famous, in which connection Fraser narrates that Mammush Khan, chief of the Zafaranlu Kurds,* owned two so swift that, when shortly after the death of Nadir Shah, Chinárán was besieged by Ahmad Shah, the Afghan, a daily service was maintained with Meshed, forty miles distant, in spite of all attempts to cut off the messengers.

The chief object of my visit was the Mil-i-Radkán, or "Column of Radkán." This, as a reference to the illustration proves, is not a column but a circular edifice supporting a dome of conical shape. Round the body of the building, resting on a high plinth of uncoursed stone, are half-columns of brick, above which is a much mutilated Kufic inscription showing remains of blue tiling. The exterior circumference measured 150 feet, with an interior diameter of 23 feet. The height was perhaps 70 feet. The walls were 6 feet thick. As ever, legends were numerous, and there is one, according to which it is the tomb of Arghun, termed Argawán by the Persians, who was closely connected with Khorásán and has given his name to one of the natural portals of Kalát-i-Nádiri. Curiously enough, to the south-west of Astrábád is a second Rádkán, with a somewhat similar but smaller building. About a mile to the north-west are the ruins of ancient Radkán. Indeed this district is full of interest as the ranges to the east culminate in the Kuh-i-Hezár-Masjid, rising to an elevation of 9800 feet, which was examined by us the following spring. On its summit

* To-day, the Zafaranlu Kurds inhabit this district, Láin (to the north of the Hezár Masjid range) and Khákistar. Their two divisions are (*a*) Kiwánlu and (*b*) Sheikhwánlu.

I was fortunate enough to see a *Kabk-i-dari*,* or "Royal partridge," the existence of which, in this part of Persia, was quite unknown. There was also a remarkable defile, termed the Zu-i-Ardak (Zu is Turki for defile), where, in places, the sheer cliffs were only a few feet apart and, at one point, the river fell hissing into what would undoubtedly be termed "The Devil's Cauldron" in England. The rock scenery was unsurpassed, and the wealth of bird life and flowers in this hitherto unknown gorge was extraordinary.†

Again, across the valley, in the heart of the Nishapur range, is the sacred lake termed Sovar by the Zoroastrians, Su in the *Shah Nama* and to-day Chashma-i-Sabz, which I visited in 1909. Situated at an elevation of over 7000 feet, not far from the Luk Shirbad peak, which rises above Nishapur to 10,700 feet, its area to-day is 400 yards by 100 yards; but it was evidently a much larger body of water in the past. It is mentioned in connection with the "Fire of the Labouring Classes," referred to below, and its sanctity was, perhaps, in part due to its being the habitat of the otter, to kill which was death by Zoroastrian law. In the *Shah Nama*, it is famous for having been the place where Yezdigird the Sinner was kicked

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* *Dari*, originally signifying "of the Gate," came to mean royal. Cf. Pharaoh, the Bab-ul-Humayun, and the Mikado, all bearing a similar meaning. The *Kabk-i-dari* is really a snowcock, and not a partridge.

† Major Watson noted the following birds and mammalia in the Kuh-i-Hezar-Masjid range and this gorge :—

Lammergeyers.
Various eagles, buzzards, vultures, and kites.
Kestrel hawks.
Sparrow hawks.
Merlins.
Woodpigeons.
Blue rock pigeons.
Turtle doves.
Sandpipers.
Dotterels.
Night herons.
Red-legged partridges.
Sand partridges.
Kabk-i-dari, or "Royal partridge."
Quails.
Woodcock.
Blackbirds.
Ringouzels.
Water-ousel or dipper.
Missel thrush, fieldfare.
Blue rock thrush.
Blue and red rock thrush.
Common redstart.
Chats, various.
Pipits.
Chaffinches or goldfinches.
Buntings.
Warblers, various.
Nightingales, Persian.
Flycatchers, various.
Cuckoos.
Hoopoes.
European bee-eaters.
Rock-creepers.
Ravens.
Hooded crows.
Choughs.
Swallows.
Swifts.
Martins.

Mammalia.

Wild sheep.
Ibex.
Wolf.
Fox.
Mouse-hare.
Hare.
Leopard.

by a white horse which arose from the lake. This ultimately caused his death, and, according to the legend, he died at Chashma-i-Gulasp—to-day known as Gilás—on the opposite side of the valley.

Some 15 miles north-west of the sacred lake is an elevated, scarped spur, known as the Purda-i-Rustam, or "Curtain of Rustam," containing some interesting caves, which had once been fitted with doors. These I examined with Professor Williams Jackson in 1907. Edible earth, known as Gil-i-Armeni, or "Armenian clay," is extracted from other caves in these hills close by. In this connection, earth eating is apparently an ancient if deleterious habit, as Ibn Hawkal mentions a mine of the clay between Kain and Nishapur.*

From Seiidábád, which, owing to the saintly descent of its inhabitants, pays no revenue, we marched west towards the turquoise mines. The district for some miles was inhabited by Shamlu Kurds and forms part of the Kuchan government; but, at the end of a somewhat long march, we camped near Chakana, the capital of the Sir Vilayat district. It is of interest to note that this is the first pass across the main range north-west of that *viâ* Sharifabad, which is passable by waggons. In other words, from opposite Meshed to this break in the hills, a distance of 40 or 50 miles, all armies marching east or west had to cross this pass, if using wheeled transport, or, indeed, if in large numbers. Further north, there is no other pass for many miles. This fact, which is of some military importance, will be again referred to in connection with the route of Alexander the Great, who had wheeled transport. The term "Binalud," which appears on the map as a general name for the range, is incorrect, each mountain having its special nomenclature. The inhabitants of Sir Vilayat are all Beiat Turks who, according to their own account, were transported to this upland district by Nádir Sháh from the vicinity of Hamadan. They now number 3000 families, and were governed by Jalil Mirza, ex-director of telegraphs in Khorásán. During the course of the march we met what is known as a "pilgrim stone." These rounded boulders are believed to be so actuated by yearning to visit the tomb of the *Imám* Rizá at Meshed that, without any human agency, they can accomplish their journey to the sacred city! At the same time, it is a pious deed to help them on their way, and so travellers and pilgrims vie in rolling these great stones along.

Our next stage lay across the Sultan Meidan plain, and, a few miles from the mines, the governor, an old friend of Major Watson, met us. Under his guidance we crossed the low range, in which the mines are situated, and found our camp pitched near the unattractive village of Madan, or "Mine," which is divided into the "Upper" and "Lower" fort.

The mines are situated some hundreds of feet up the hillside, which is

* *Vide* "Earth-Eating and the Earth-Eating Habit in India" in the *Journal of the Asiatic Society of Bengal*, No. 12, pp. 249-270, for much interesting information on the subject.

of a magenta hue, and the one we visited is entered by a tiny iron grille. Two almost indispensable articles were a pair of cotton shoes and a cap to protect the head; but our Persian host had thought of neither, so the scramble down in shooting boots was not particularly easy. After descending perhaps 100 to 150 feet and creeping for some distance along a lateral gallery, we reached a more open part where, by the uncertain and evil-smelling light of primitive earthenware lamps, two parties were quarrying the rock by means of chisels and hammers. The blocks, which are more or less blue, are roughly broken up and carried in bags to the surface by boys. This was all there was to see in the mine; but, above, we were treated to an explosion which, somewhat to my relief, passed off without an accident. Returning to the village we witnessed the next operation of sorting the turquoises. The contents of the bags of rock were poured into shallow circular pans, into which water was run. The fragments were then worked by the feet of six boys whose energies were stimulated by the presence of two men with rods. After half an hour of this treatment the rock was again washed and examined, the process being repeated three times, when the turquoises which are still in the rock are sorted into bags and sent into Meshed. There consignments are purchased by the merchants and the stones are ground by a primitive wheel. It remains to be added that the best stones are found by digging in the skirt of the hills. They are known as *Khaki*. Nowhere, too, should that well-known maxim of *Caveat emptor* be more carefully observed, as, by keeping the stones moist, their colour remains blue; but, if allowed to dry, they frequently turn a sickly green. Upon the whole, I came to the conclusion that if the mines did not compare favourably in management with those at Kimberley, which were the last I had visited, yet their output is quite sufficient to meet the limited demand for turquoises, so far as Europe is concerned. At the same time, to a lover of turquoises, it is sad to notice that, in the case of even the best London jewellers, the majority of the stones offered for sale are of very poor quality. In Persia there is a steady demand for the stone. India purchases a few good and many indifferent stones, the worst of all finding a ready market in Arabia. It is curious to learn that the ancestors of the miners migrated from Badakshan some generations ago. This province of Afghanistan is famous for its ruby and lapis-lazuli mines.

From Madan, we marched approximately west across a very level plain to the village of Robát. Upon inquiry, the inhabitants stated that the ancient name was Robat-i-Karaji. This was a fact of some interest as Amir Ali Shir, Vizier of Sultan Husein, Baikará, built eight such "robat" between the city of Gurgán and Meshed, one of which went by this name; but had never been identified. To-day nothing but a shapeless ruin is left to mark the site of the caravanserai, which was built at the end of the fifteenth century. Robát was in the Safiabad district; but, further north, we entered Juwein, a sub-district of Sabzawár. At about 17 miles

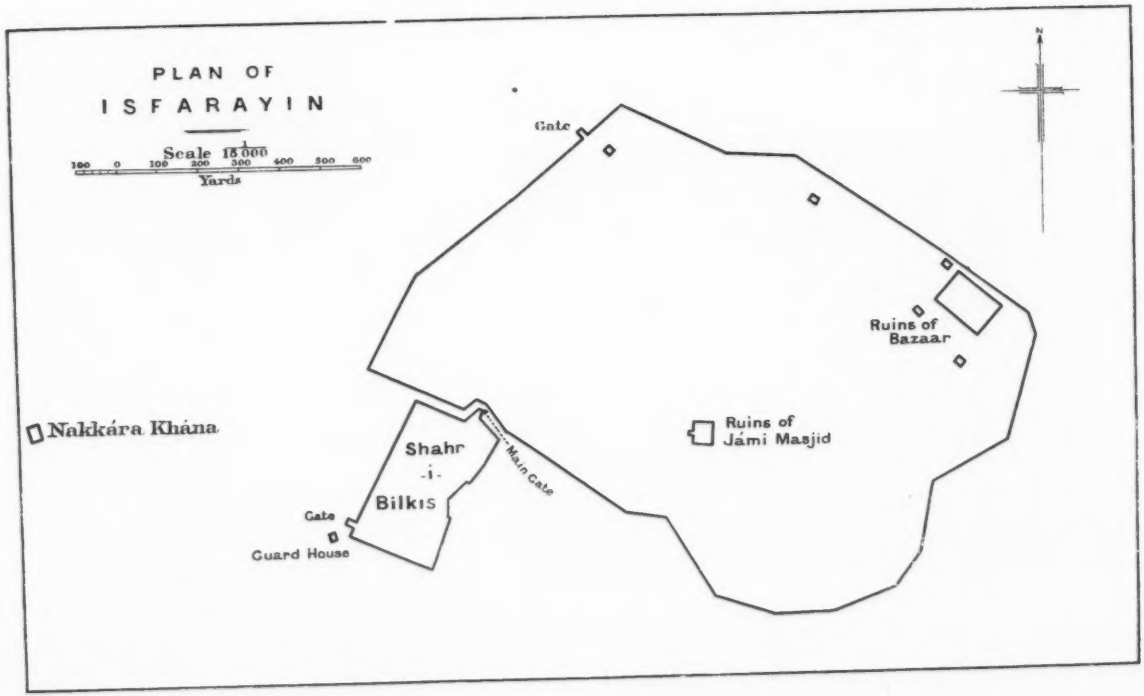
we identified yet another of the "robat" referred to above, known as Robát-i-Kili, and we camped at the large village of Hukamabad, which is inhabited by Turks, who were brought from Sarakhs some five generations ago, probably by Nádir Sháh. To the north lay a very salt river and a fine meadow, where we saw flocks of sandgrouse and a few duck.

The following morning we crossed a very low range of hills, which has figured vaguely on the map as if of importance, and, after traversing some broken ground, we entered Kuchan territory at Geráta, which is inhabited by Malálu Kurds. We thence ascended to a low pass which forms the boundary of the Isfarayin district, and, looking down on to the fertile valley which, like the district we had traversed since quitting the mines, is almost a blank on the map, we were pointed out Miánábád, its chief centre surrounded by extensive gardens; behind it towered the superb Sháh Jahán range, with its gold-mines, which are worked spasmodically. Upon reaching the fertile plain, Shahr-i-Bilkis, the ancient fort of Isfarayin, rose up out of the plain, and appeared to be quite close, but the stage was just 30 miles in length and it was night before the whole party was in.

The city of Isfarayin is mentioned by Mukaddasi as being very populous and as possessing good markets. Yakut states that Mihraján was its ancient name, and that the fort was termed *Kala-i-Zar*, or "Gold Castle." * As a reference to the plan shows, its walls are still traceable and its Jami Masjid, or "Mosque of Assembly," only became a total ruin some fifty years ago. Almost touching the ancient city on the south side is the very strong fort of oblong shape, which stands on a mound rising some 30 feet above the level plain. Passing through the gateway nearest the city, an outer work is entered which is commanded by the main fort. On the inside of the massive walls are remains of a gallery, and, generally speaking, the work impressed me as being of exceptional strength. About half a mile to the west is a second mound, termed the *Nakkára-Khana*, or Drum-house. This term is frequently applied in Persia without any special reason. Shahr-i-Bilkis (Bilkis is the Queen of Sheba mentioned in the Koran) is a comparatively modern name for what was invariably known as the city of Isfarayin, and is not used by any of the Arab travellers. The site was littered with fragments of mediæval pottery, and a few coins were produced. One of these was a silver piece issued by Harun-al-Rashid; another, of later date, had "Juwein" on one side and "Ali Vali," or "Ali is the Regent," on the other.

The district we had been exploring lay inside the arch of the great range or series of ranges which run in a north-west direction as far as Kuchan, but then trend to the south-west. Consequently, we had to cross a high pass before reaching Bujnurd. This we accomplished in two marches, and, at Garawán, which lies on the northern slopes of the Alá

* *Vide* Guy le Strange's 'The Lands of the Eastern Caliphate,' p. 393. It is impossible to overestimate the value of this work to students of mediæval geography in the Near and Middle East.


PLAN OF
ISFARAYIN
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100 0 100 200 300 400 500 600
Yards
N
Gate
Ruins of Bazaar
Nakkára Khána
Shahr -i- Bilkis
Main Gate
Ruins of Jámi Masjid
Gate
Guard House

Dágh below the Kotal-i-Sia Khána, we received a very polite letter from the *Ilkháni* or chief of the Shahdillu Kurds.

To Bujnurd, we rode down a very fine gorge, which opened out at the summer retreat of Firuza, where mistletoe was to be seen growing in the orchards, the first time Major Watson or I had noticed it on the Iran plateau, although we afterward saw it at Bostam. An *istikbal*, or "reception party," met us, and we were conducted to a very fine bungalow, which the late Ilkháni had built. In the afternoon, the Sirdár-i-Muaziz and his brother, the Sálár-i-Mufakham, called and were most friendly. They evinced much pleasure at our visit; and referred to Colonel the Honourable G. Napier, who is quite a historical personage at Bujnurd, and to Colonel Yate, whom I actually preceded in the Turkoman country and at Bujnurd, although in other places, notably at Shahr-i-Bilkis, he has been my solitary predecessor. The following morning we visited a garden built by Najaf Ali Khan, who had entertained the distinguished traveller Fraser nearly a century ago, and shot our first woodcock. We also followed Colonel Napier's example, and shot snipe in the marsh close to the town.

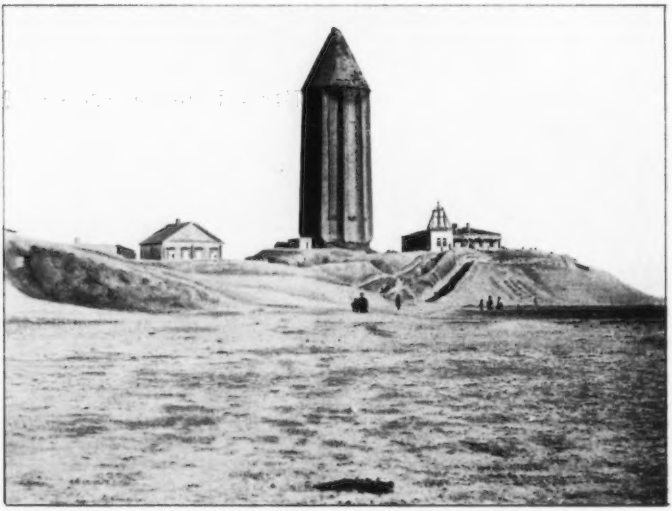
The second day we were shown over the palace with its huge reception rooms and tiled porticos, which are quite out of place at rustic Bujnurd, and lunched in a room crowded with musical boxes and candelabra. In the afternoon, we rode back towards Firuza to visit the tomb of the late *Ilkháni*, at Besh Kardash, or "Five Brothers." The shrine, as it has now become, consists of a central blue dome and two side arches, with four minarets. The building is approached by a fine flight of steps and looks on to a warm spring shadowed by gnarled plane trees and inhabited by large fish. The tomb chamber is panelled with marble and is beautified by a band of exquisite old blue tiles, taken from a shrine at Jájarm. In the wall are set two slabs, one of which gives details of the land forming the endowment, the other containing a curious autobiography of the late chief, who, in it, claims to have rescued more than 2000 prisoners carried off by the Turkoman, and also refers with pride to his visit to Europe! Returning to Bujnurd after dark, we passed through the ruins of Charmakán, which, according to the Governor, was an ancient site. Three miles to the north-west are the ruins of ancient Bujnurd, or Bizhan, as they are also called.

I have made inquiries from several sources as to these sites, with the result that it appears probable that Samangan, referred to later in this paper, was the most ancient capital, which was destroyed by Chengiz Khan, when Charmakán succeeded it. Charmakán was followed by Bizhan, also close by; and Bujnurd is quite a modern town. It is believed that the Shahdillu Kurds, who now own Bujnurd, were originally planted by Sháh Abbás in the Akhal Oasis and the Balkán range. They were, however, too weak to hold these districts against the Turkoman, and fell back south, dispossessing the Garaili Turks. The story runs that, being invited to a wedding, they murdered all their hosts! This story, which is

IN THE KUH-I-HERAZ RANGE.

IN THE GURGAN DEFILE.

GOKLAN IN CENTRE, WITH TWO SONS ON RIGHT AND LEFT.



THE GUNBAD-I-KABUS.

substantially correct, might imply that Charmakán was the Garaili capital which the Kurds destroyed, Bizhan being founded in its place; but this is only a conjecture. To-day it is estimated that the district is inhabited by 14,000 Shahdillu Kurds and by about 4000 Garaili Turks. The mother of the present chief was of a Garaili family.

Upon quitting Bujnurd, we rode west across the hills to the fertile district of Samalgán, a corruption of Samangán, and camped at Sháhábád, the chief village of the valley. Four miles to the north lie the ruins of ancient Samangán, where Rustam wooed Tamína, whose son was the illustrious Sohrab. As the *Shahnama* especially refers to the district as being situated on the borders of Iran and Turán, there is every likelihood that this is the site referred to by Firdausi. The derivation of the name from Samán Gáh, or "Place of Horses," seems to be probable. At any rate, the district has always been noted for its grazing, in which connection I was informed that when Nádir Sháh was engaged in operations against Kuchan, which terminated in his assassination, his brood mares were kept in this district; and, that when the Turkoman of the Gurgán heard the news, they successfully raided the whole stud, from which date their horses became famous for speed, endurance, and docility. Indeed, all the Kurds ride Turkoman horses whenever possible. The district is mentioned by the great geographer Yakut, who terms it Salmakan. He narrates that he passed through it in A.H. 617 (1220), when fleeing from Merv before the Mongols.

Our inquiries for curios were rewarded in this district by a beautifully worked copper *Kashkul*, or beggar's bowl, being brought for sale; it had been dug up in the ruins of Ashkhána, near the site of Samangán. This name Ashk, which appears frequently in Khorásán—in 1905 I noticed it in the Tabas district—is clearly of Parthian origin, the royal family being termed Ashkáni.

As Samalgán was the only district possessing supplies until the Gurgán valley was reached, we left our main camp behind and continued our journey to the borders of the Turkoman country, the Turán of Firdausi, with a light camp. We kept to the north of the main route traversed by Colonel Yate in 1894, although, when stalking in the hills, we were pointed out Robát-i-Karábil, at which he halted. Our route, at first, lay up the fertile valley which, situated near the Turkoman frontier and being also the granary of Bujnurd, has been raided again and again. The ruins of Heidarabad, a large village, afforded full proof of this. It was strongly fortified, and must have contained a considerable population, but Tukmi *Sirdar*, the famous Tekke leader, rushed it at dawn one morning, and slew or carried off the entire population. To-day, only the bare walls are left. Ruins indeed abounded, and between the two important villages of Shahrá bád and Kala Kázi we were pointed out a mound termed Misr-i-Aywán, which I have not been able to identify. From its name, "Arch of Egypt," it was probably a village founded by the Arab conquerors.

Our guide was a *Yuzbashi*, or centurion, and with him were some Kurd sowars, manly fellows, all mounted on Turkoman horses. The *Yuzbashi* was a Gaudari Turk by descent, and his home was Dasht at the head of the Gurgán gorge; but, owing to the fresh blood-feud with the Turkoman, he had left his village; he, however, hoped to return there in the spring. Indeed, this question influences relations so intensely on the frontier that it seems desirable to give the facts of the recent raid. In the autumn of 1907, the Yamut and Goklán Turkoman were induced to sink their differences, and to join in a raid on Khorásán. The Bujnurd sowars united with those of Nardin to stop the raid, but were defeated, both sides losing thirty to forty men. A month later they had their revenge as the Turkoman were seen returning laden with booty, clouds of dust betraying their presence. The brother of the *Ilkháni* took possession of the fort of Garmáb near Jájarm, and also sent a party to a flank to lie in ambush. The Turkoman, who always fight on foot, were ultimately defeated with heavy loss, and many prisoners were taken and still more captives were released. Among the Turkoman prisoners was an old man of ninety, who said that he had joined the *alaman* in order to secure a new wife! The damsel in question came up during the interrogatory and brained her captor with a stone! During these raids, past and present, the Turkoman appeared to have enjoyed a great and permanent advantage, in that neither Kurd nor Persian ever carried off their women or children owing to their ugliness. The Turkoman, on the other hand, preferred Persian to their own women, and thus had a keen incentive, apart from the purely commercial aspect, to engage in these forays, in which no mercy was ever shown to the aged or weary. In the autumn of 1907, there was a Persian triumph at Meshed, in which some Turkoman prisoners and many heads on poles were displayed, which were the fruit of this engagement.

To resume, from the Samalgán valley we kept to the north of the main range, termed the Kuh-i-Gurkhud, across unsurveyed country, camping the second night in the valley of Chálbásh. In this neighbourhood Major Watson and I enjoyed exceptionally good stalking, and being on the Kurd-Turkoman frontier, where shooting at sight was the rule, shikarries were few. The wild sheep run to a great size, and one of eleven years, which was shot by me, had horns 38 inches in length and 11½ inches in circumference. Both Major Watson and I secured specimens of the ibex; and he was fortunate enough to bag two young leopards.

At Kara Tikán, some five miles from Dasht, we were on the edge of the forest which stretches without a break across the south of the Caspian sea, and here consisted of stunted oaks and maples, with a particularly thorny undergrowth. Tigers and leopards abounded, to judge from their tracks, but, owing to the cold—we camped on snow—it was impossible to sit up at night. In this connection, this range provided Rome with tigers for its games, so far as I recollect. At any rate, did not Macbeth say?—

> "Approach thou like the rugged Russian bear,
> The arm'd rhinoceros, or the Hyrcan tiger."

A very large stag—the *Cervus elephas maral*—and a roebuck also inhabit these woods, and of the former a very fine specimen with fourteen points was secured by me after a most exciting stalk. To conclude the list of big game, wild boar abound, and the tracks of a bear were seen in the snow.

At Dasht, where the houses of the village have been gutted, we parted with regret from our Kurds, and marched down the Dahána-i-Gurgán with a Goklan, Oraz Mohamed, whom the Bujnurd chief had thoughtfully supplied to act as a guide, as no Kurd would venture down the gorge; trade, too, is practically at a standstill. By a curious coincidence, Oraz Mohamed had been my guide fifteen years previously along the Atrak, and produced with much pride a present which I had given him.

The scenery of the Dahána-i-Gurgán was extremely fine. At Dasht, the oaks were stunted and naked. However, as we descended, we found oaks, beeches, elms, maples, and sycamores, not only much finer, but, at the bottom of the gorge, they were still in leaf; there was also much mistletoe. The cliffs rose up for thousands of feet in places, and as the gorge is never very narrow and winds throughout, presenting exquisite views, one could only regret that such a magnificent country was uninhabited. At Ishaki, about halfway down, there was once a village, and it should be an ideal centre for sport; but, as both time and supplies were running short, we pressed on. Finally, the hills receded and we came to a clearing inhabited by Goklan Turkoman of the Kai section who, not unnaturally, mistook us for a raiding party and disappeared into the jungle. When confidence was restored, they avenged themselves for their fright by charging famine rates for supplies! No chopped straw or dried lucerne had been procurable west of the Samalgán valley; but there had generally been good grazing. Now, however, until we crossed back on to the Iran plateau only rice stalks and scanty supplies of barley were available, and our transport suffered considerably. Rice was cheap, but flour very dear.

In the morning, as we were starting, we were welcomed by Mohamed Geldi Khan, cousin and successor of Subhan Kuli Khan, who had entertained Colonel Yate. Having heard that ancient sites interested me, he at once took me to one near our camp at Tang-i-Rah. It consisted of a mound faced with large boulders, above which was an upper bank similarly strengthened. The summit was 25 yards square and was surrounded by a ditch. Known as Takht-i-Suliman, or "The Throne of Solomon," this fort could not have been very ancient, as the boulders not being set in mortar would hardly have remained in position; but the type was entirely novel to me. The forest, so far as the valley was concerned, practically ended at this point. There were extensive rice fields, but, with this exception, the country was covered with low scrub of various descriptions. Farther down was Shaghal Tappa, near a stream. The conical mound is perhaps 50 feet in height, and was probably crowned by a fort.

The Turkoman, however, know nothing of these questions, and can only refer to the Geraili Turks, whom they dispossessed many centuries ago, and who still inhabit the villages on the skirt of the hills.

Close by Shaghal Tappa we were invited to lunch with Mohamed Geldi Khan, and found two young Greeks from Bujnurd, and also a Russian Armenian trader, all staying in the camp. The former were selling silk "seed," and the Armenian bartered tea and sugar for cattle. After lunch we shot our first pheasants, *Phasianus colchicus*, which are more like the English bird than the "Prince of Wales's pheasant," which is found on the Kashaf Rud; and, near the camp, we saw clouds of the pintail sandgrouse. Close to Chakur, which is the chief centre of Gurgán, as the Goklan country is termed, we crossed the river and rode across the important ruins of Shahrak, as to the history of which I could learn nothing.

The Goklan Turkoman have, since my former journey, become even more addicted to the curse of opium smoking, and struck us both as weakly and sickly. This is partly due to the fact that they have settled down but still live in their *alachik* or dome-shaped tents. The result is much more dirt and less sanitation than in an ordinary nomad encampment, which is saved by frequent changes of site. Another point is that, although the hills are close by and offer cool retreats during the summer heat, no advantage is derived from their propinquity.

From Chakur, we visited the Takht-i-Rustam, a hill fort of small importance, situated several hundred feet above the plain on a spur. Our view ranged across the valley which is, sad to say, almost entirely covered with reed brakes, above which occasional mounds, marking sites of deserted towns and villages, show up. In the rare clearings, flocks of a species of small bustard * feed, of which we bagged a large number, mainly by having them driven over us; indeed, all this country is a paradise for sport; but it is deplorable that a handful of miserable Turkoman—the Goklan tribe which is not increasing, numbers but 2500 families—should occupy thousands of acres of the finest and best-watered lands which I have seen in Persia.

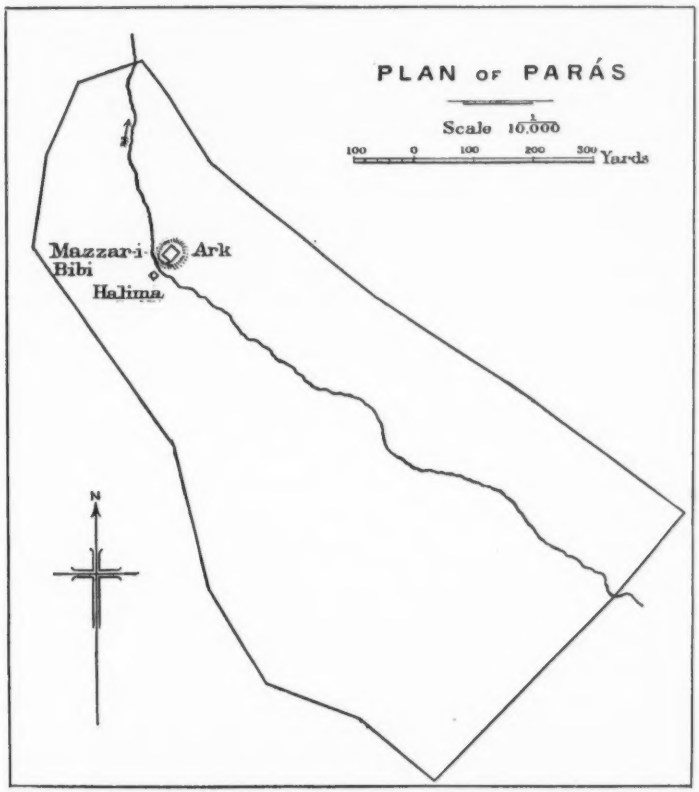
Below the Takht-i-Rustam, we visited the first of the very picturesque villages which line the range. Its inhabitants, who are mainly Garaili Turks, call themselves Persians, and spoke Persian; and their hay, which is stacked high up on a platform, as also their houses, offered a striking contrast to what is usually seen in Iran. We reached camp after sunset, and were informed that the main party had been fired upon by some shepherds, who took it for a raiding party. They finally saw their mistake and, when we met them later on in the day, were most friendly.

Close to our camp, termed *Khar*, or "Donkey," lay the ruins of Parás, which encloses a considerable area. Its shape, as the plan shows, is an irregular oblong running from south-east to north-west, with a fort 28 yards square near the west wall. From it we gained a clear view of the

* The *Otis tetrax*.

famous Gunbad-i-Kábus, which bore 250° and was distant 14 miles. To the north, a few miles away on both sides of the Gurgán, are the ruins of Darra-Gaz. Both these ruins are of importance, and will be referred to again.

Leaving Paráis we rode, as on the two previous days, through belts of high reeds, passing Kala Gaour, a mound which marks an ancient site.



At 6 miles beyond it, we were in Yamut country, and, crossing the Kara Su shortly afterwards, we left the reed brakes behind and entered the steppe. The first sight which met us was that of an old Gan Yokmaz Turkoman ploughing with a camel and a mare, and, needless to say, Major Watson speedily took a photograph of this curious team. The "Gunbad" had been looming larger and larger as we approached, and, passing the ruins of Haji Lar, we soon reached this remarkable landmark,

where we found our camp pitched beyond the Russian cantonment. In the afternoon we called on the Russian Commissioner, Colonel Lavrov, who, throughout our stay, showed us much hospitality and kindness.

The Gunbad-i-Kábus, or "Dome of Kábus," was first discovered by Fraser, who was unable to identify it,* and, to Colonel Yate, so far as I know, belongs the credit of first translating the inscription, which is of much importance.† As the illustration shows, the "dome" is, in reality, a high fluted brick tower, which bears a family likeness to that at Radkán. It is a decagon outside with a perimeter of 180 feet, and its height is about 200 feet. The Kufic inscription, which is made out of raised brickwork, is in duplicate bands, and states that Kabus, son of Washmgir, ordered the tower to be built as a tomb during his lifetime, in A.H. 375 (997). Kábus was the famous prince of the Ziyarid dynasty, whose cruelty brought about his overthrow but whose memory will never fade in Persia. His grandson wrote the delightful 'Kábus Nama,' which lays down what are, upon the whole, very wise rules for life under all conceivable conditions, and even devotes one chapter to the game of polo. Sad to say, the bricks round the base of this fine building, which is also a wonderful landmark, have been extracted, and, unless the Russian Commissioner executes the necessary repairs, this historical edifice, with an authentic history of nearly one thousand years, may soon be a shapeless mass of bricks, and might quite possibly destroy the Commissioner's house situated close to its southern side, in its fall.

The following morning we rode to the Gurgán, distant less than a mile, which, at this point, flows between high banks in a muddy stream some 30 yards wide, and crossing it by a wooden bridge, we proceeded west for 3 or 4 miles to a mound termed Karaul or "Watch" Tappa, which originally formed a post on the famous Sadd-i-Sikandar, or "Barrier of Alexander." This great work, locally termed Kizil Alang, or "Red Wall," runs at a bearing of 250°, parallel to the Gurgán; and is said to have been built by the Great Conqueror to delimit Turán and Iran. However that may be, its origin is lost in the mists of antiquity and the first reference to it I have come across in Persian history is one, according to which, it was repaired by the Sasanian monarch, Noshirwan. It seems probable that it was constructed to keep raiding nomads from cultivated Iran and, like the Great Wall of China, was possibly useful, although the expense of garrisoning and repairing it must have been great.

Where we inspected the great work, there were fragments of red bricks on the south side, and then a faintly traceable hollow, marking where the ditch had once been. This "barrier" undoubtedly stretches from the Caspian to the upper reaches of the Gurgán; but, beyond that, I have no accurate knowledge of its existence, although, locally, it is said to run as far east as the Oxus.

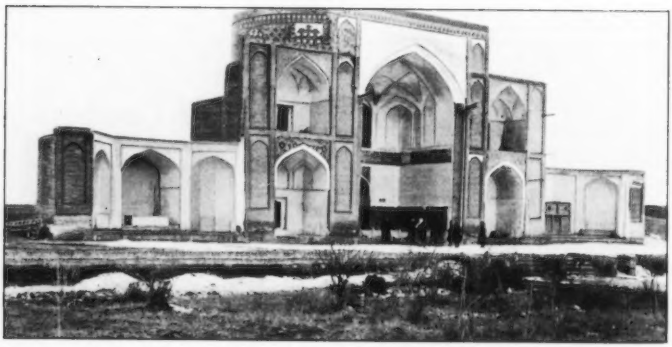
* *Vide* 'A Journey into Khorasan,' p. 612.

† *Vide* 'Khorasan and Sistan,' p. 240.

A HOMESTEAD IN THE GURGAN VALLEY.

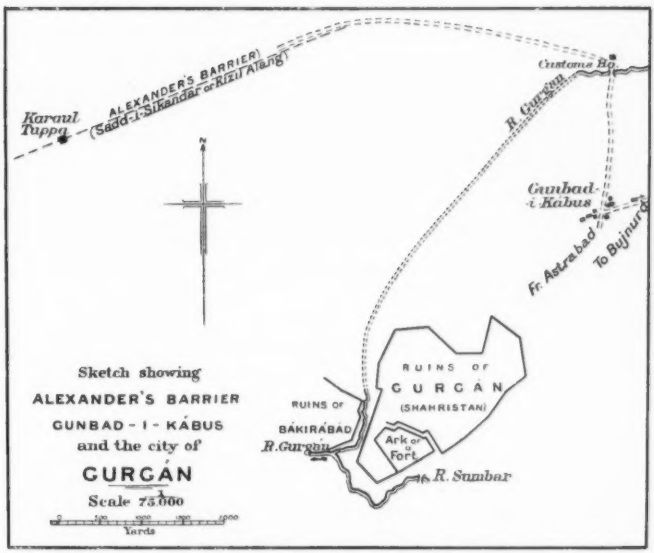
THE KUZLUK PASS LOOKING NORTH (THE ELBRUZ RANGE).

THE "SHAKING MINARET" OF BOSTAM.



SHRINE OF SHAHZADA MAHRUK (TOMB OF OMAR KHAYYAM VISIBLE IN LEFT WING).

The ruins of erstwhile famous Gurgán, which was Arabicized into Jurgán, lie, as the plan shows, some 3 miles to the south-west of Gunbad-i-Kábus and not to the north-east, as the latest maps show; indeed, the maps of this valley are much more misleading than useful. Gurgán was the capital of a province of the same name, which included the valleys of the Gurgán and Atrak, and corresponded with ancient Hyrcania and Parthia. As the plan shows, the walls of Gurgán are traceable, although they have sunk down into the mound stage. The city was situated on both banks of the Gurgán, up which ships came from the port of Abaskun, which has now disappeared into the Caspian. The quarter on the left bank was



known as Shahristan and that on the right bank as Bakirabad, the latter name still surviving. The Ark is situated near the juncture of the Sumbar with the Gurgán, and is very slightly raised. Mukadassi, in the fourth (tenth) century, describes the fine mosques and gardens, and refers to the square facing the Governor's palace. He also expatiates on the superb olives, oranges, lemons, and other fruit, and waxes especially eloquent about the output of silk; and it is sad to think that the Mongol cataclysm and subsequent nomadization should have turned such a fertile district into a dreary area littered with bricks, which latter, by the way, are being used in the construction of the modern town round Gunbad-i-Kábus, which, under Russian auspices, is beginning to attract a settled population.

From Gunbad-i-Kábus the most direct route to Astrábád runs down

the right bank of the Gurgán to Ak Kala; but as my previous journey had led me to this ancient fort, and I knew the steppe quite sufficiently well, it was decided to make for the main range at Rámián and thence to skirt it into Astrábád. Our direction lay south and in time, leaving the treeless steppe behind, we re-entered the zone of forests and camped at the large village of Rámián. Some miles up this river, at Sufid Chashma, is the Russian summer station.

I had intended to visit Kala Márán, a large flat-topped hill with a perimeter of many miles, which bore 200° from camp, and on which are ancient remains, good grazing and springs of water; but heavy rain put this out of the question, as the range was already a foot deep in snow. Instead, as our time was short, we decided to press on towards Astrábád and, accordingly, we skirted the range, riding through the most beautiful forest scenery. The trees were very fine, and, for the first time, we saw masses of ferns, wild vines, and other creepers. The crowning delight was, however, a thick carpet of snowdrops which almost concealed the brown leaves. After a short march, as the whole party was soaked through, we stopped at the delightfully picturesque village of Sar-i-Chashma, where, by dint of much persuasion, we succeeded in getting the whole party under cover. At night it cleared up, and, towering above us, rose flat-topped Kala Márán, which is more accessible from this hamlet than from Rámián.

The following day we traversed park-like Findarisk, which is a district and not a town, as shown on the map. We spent the night in the district of Katul, where, at the chief village of Aliábád, we found a most friendly telegraph clerk, who not only insisted on vacating his house in our favour, but also enabled us to regain touch with Meshed and receive the news of the world. From Katul, one long march brought us to Astrábád. From some miles out, I sighted Ak Kala, the Persian fortress on the Gurgán, which has now been deserted, even the very guns * being left behind. Needless to say, the Turkoman have utterly gutted it.

Astrábád, when approached from the east, appears to be well set up, and, from a considerable distance, a clump of very lofty plane trees is most conspicuous. Upon passing through the city gate the contrast between it and towns on the Irán plateau was most striking. To begin with, the street was so wide that there was room on both sides for the black tents of the Jugis, as gipsies are termed in this district, whereas, elsewhere in Persia, there are only narrow lanes. The buildings, too, with their red tiles and overhanging eaves formed a delightful change, which was accentuated when one noticed that the walls were all topped with iris and other flowers. There is, however, a reverse to all this as the city is undoubtedly unhealthy, and appears to be almost deserted in summer.

* One of these guns bears the mark $\frac{4}{\text{E.I.C.}}$ with the date 1798. It almost certainly formed part of the battery presented to Fath Ali Shah by the East India Company on the occasion of Sir John Malcolm's embassy. I have to thank Major Kennion for this interesting piece of information.

We halted a day at Astrábád to rest and see the sights, among which was a most imposing *Diwankhana*, or "Hall of Audience," built by the founder of the Kajar dynasty. In front of it stretched a fine sheet of water, which, in Persia, appeals to the traveller more than elsewhere.

I now propose to touch on the various problems connected with this most historical part of Asia. The first question to be dealt with is a section of the journey of Alexander the Great from Rei or Rhages (close to Tehran), as far as Herat. Indications are not lacking as, from the pages of Arrian, we read that the great conqueror made six exceptionally severe marches, during the course of which he knocked up not only his infantry, which he left behind, but also his cavalry, of which only a small handful was able to keep up with their leader. At the end of the sixth stage he overtook Darius, who had been assassinated by Bessus. Now Persian tradition assigns Damghan, which is 207 miles east of Tehran, as the scene of this tragedy, and, as other indications agree, this identification seems to be reasonable.

From this centre, Alexander swung due north to subdue Tapuria—obviously Tabaristan, the ancient name for Mazanderan—and thence he marched to Zadracarta, as Arrian terms it, or Tape, according to Strabo, the capital of Hyrcania. The site of this ancient capital still awaits identification; but as Arrian mentions that it was opposite the waggon track across the range, it is at least possible that Astrábád, which is situated to the south of the best and easiest pass across the great Elburz range, or some adjacent site may have been the city referred to.

From Zadracarta, Alexander "began his march towards Parthia and thence to the confines of Areia (*sc.* Khorásán and Herat) and to Susia," the mediæval Tus. The site of the Parthian capital, termed Hecatompylos, *i.e.* "A hundred pylons or gateways," is still unidentified. It has generally been located at Damghan by German and English writers; but, apart from the fact that this town was probably outside the confines of Parthia at that date, I have indications which point to its being elsewhere; presumably, too, it would have been mentioned before as the capital of Parthia, in connection with the death of Darius, had Damghan been the site.

Arrian, by far the most accurate historian, narrates, as quoted above, that after quitting Hyrcania, Alexander marched into Parthia; and this surely points to the fact that at any rate the capital of the province had not then been visited; and makes it reasonable to suppose that it was situated somewhere in the Gurgan valley.

To follow Alexander's route a little farther, for physical reasons he must have marched up the Dahána Gurgán, and equally he must have debouched into the Susia or Tus valley by the route by which I crossed the range from Seiidábád to the turquoise mines. Close to Dasht is a famous meadow termed Kalposh, where also there is a legend of the passage of the World Conqueror, and as this lies on the direct route from the Dahána Gurgán to the pass I have referred to, it may be accepted that from the

head of the Gurgán defile, Alexander marched, *via* Kalposh, across Juwein to the pass in Sar-i-Vilayat, and so to Tus and Areia.

Another point on which I gained some information was that of the history of the Parthians. As stated above, the first notice of them is in the great inscription of Darius at Behistun, where they are termed "Parthwa," and are mentioned with the neighbouring "Varkana," or Hyrcanians.

Arrian and other writers term them "Scyths," *i.e.* Turanian, and Strabo adds that they belonged to the Dahæ section. Now to-day, in the Akhal oasis, quite close by, is Dahistan, and to go further, the Daz tribe of the Yamut cherish a legend, according to which they are descendants of a royal family. They are also considered to be the noblest section of the Yamut tribe by their neighbours. Consequently, I cannot help thinking that these two facts are of no small importance in studying this interesting question.

To continue, Alexander traversed the Gurgán valley in B.C. 330, and in B.C. 256, the Greek satrap of Balkh, the capital of Eastern Iran, proclaimed his independence. Six years later, Parthia shook off the rule of Diodotus the Balkh satrap, their leader, according to Strabo, being "Arsaces, a chief among the Parnian Dahæ, who inhabited the valley of the Ochus." Canon Rawlinson suggests that this latter name is the Atrek.

Now local legend centres with great intensity round Parás, the ruins of which are situated quite close to Darra Gaz, which latter was originally Darabgird, or "The City of Darius," and is also considered to be a very ancient site; and it is stated that here was the original capital of Parthia. This I am inclined to accept, and would also suggest that here too we possibly have a clue to the word "Parthia" which has hitherto remained a puzzle. As Alexander is stated to have founded Hecatompylos, I would suggest that he found Parás the ancient capital, and, quite close to it, built a cantonment which he termed "Hecatompylos," but which became known as Darabgird; in no case would the Greek name be likely to have survived.

A third site which I have, I think, identified is that of the second Parthian capital which was founded by Tiridates, the second Parthian monarch, and which was also termed "Dara"—the Dareion of the Greeks. Dara is described as being situated on a hill, surrounded on all sides by precipitous rocks and placed in the middle of a plain of extraordinary fertility with forests and streams; game, too, was most abundant.

This undiscovered site is almost, without doubt, Kala Márán, which I have referred to as being a flat-topped hill, difficult of access, with ancient ruins. To-day it is surrounded by forests with copious streams, and it overlooks the very fertile plain of Findarisk. Finally, the Daz connect Kala Márán with the period of their greatness.

To conclude, it is impossible in a paper of this nature to enter fully

into details: but I think that even the brief notes I have given will explain how very anxious I was to have a chance of examining these important and, to me, extremely interesting questions.

(To be continued.)

THE EXPEDITION OF H.R.H. THE DUKE OF THE ABRUZZI TO THE KARAKORAM HIMALAYAS.*

By Dr. FILIPPO DE FILIPPI.

THE expedition undertaken in the summer of 1909 by the Duke of the Abruzzi to the head of the Baltoro and the Godwin Austen glaciers in the Karakoram was essentially a mountaineering expedition. Nevertheless, it furnished opportunities for new geographical observations of the region, of which the following is a brief account.

The expedition, consisting of H.R.H. his A.D.C., Marchese Negrotto (Lieut. R.I.N.), Cav. Vittorio Sella, and Cav. F. De Filippi, together with seven Alpine guides and porters from Courmayeur, and Sella's photographic assistant, left Srinagar on April 23, 1909. They were accompanied by Mr. Baines, an Englishman chosen by Sir Francis Younghusband, then resident in Cashmere, to give the assistance of his knowledge of the region and people. On the way out the longer summer route was followed across the Punjab Himalayas over the Zoji-La (11,230 feet), and down the valleys of the Dras and of the Indus, to Skardu, the capital of Baltistan. Here the route quits the Indus to ascend the Shigar and Braldoh valleys up to Askoley, the last inhabited spot, after which we enter the glacier region. While traversing Baltistan the expedition had the opportunity of seeing much of the Balti population, and of photographing several groups of them. There can be no doubt that the great majority of the Baltis belong to the Aryan stock and not to the Mongol-Tibetan, as has been stated by all English writers on the subject. The distinguished Hungarian anthropologist Ujfalvy had already demonstrated their close affinity to the Dards by comparative anthropometrical measurements.

A few miles above Askoley the Braldoh valley is intersected by the snout of the Biafo glacier. This glacier has undergone considerable variations in a recent period. In 1861, when Colonel Godwin Austen first visited it, it was wedged against the opposite or left flank of the Braldoh valley in such a way that the emissary stream of the Baltoro flowed through a tunnel underneath it. In 1892 Sir Martin Conway noted that it had withdrawn to such an extent as to leave free more than half of the valley, upon which it had deposited a deep layer of

* An abridgement of a lecture delivered by F. De Filippi to the Society's meeting of November 21, 1910. Map, p. 128.

moraine. Since then the movement has again been forward, and in 1909 there were only from 200 to 300 yards between the snout and the rocks of the left wall of the valley.

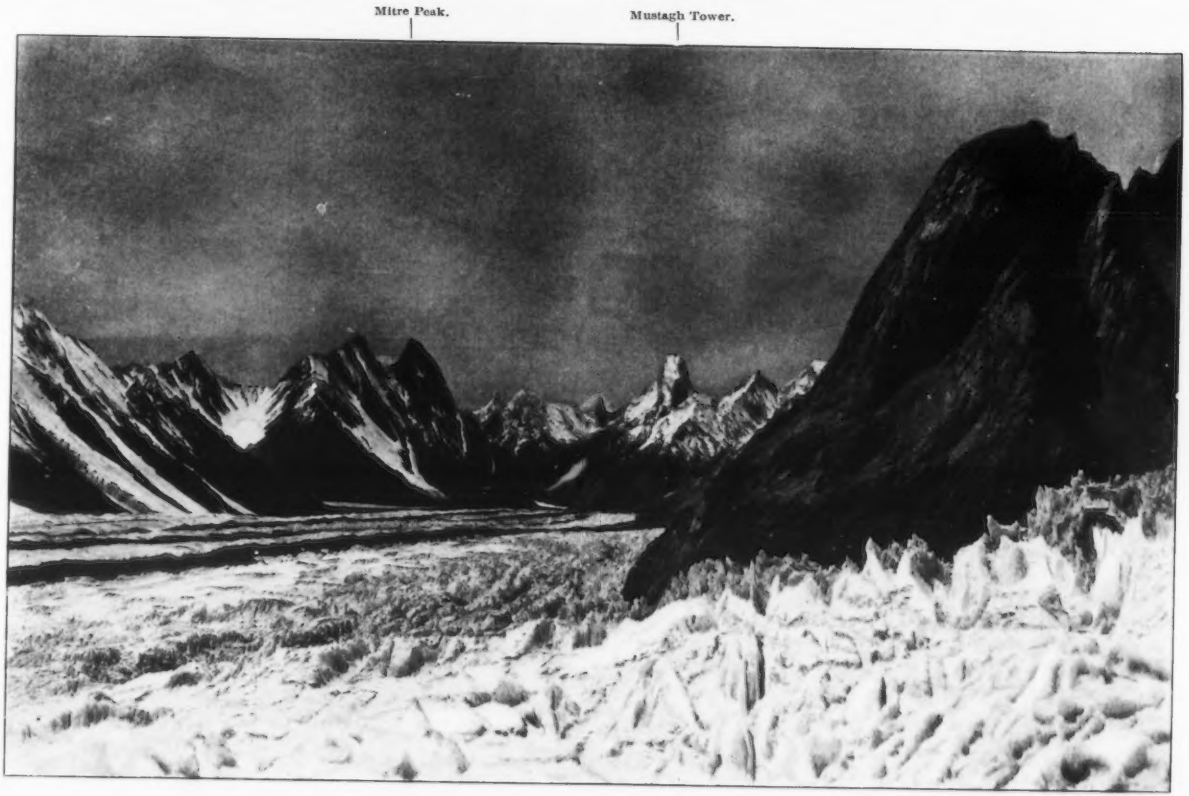
On May 18 the expedition climbed up on to the Baltoro glacier upon which they were to remain for more than two months. The snout of this glacier still corresponds absolutely with the description of it given by Conway in 1892. It may possibly be stationary, but certainly shows no sign of shrinking.

All the tributary glaciers appear to be on the increase and stretch out for a long distance on the top of the Baltoro, whose surface they strew with broken seracs. This is more especially noticeable in the tributaries to the north.

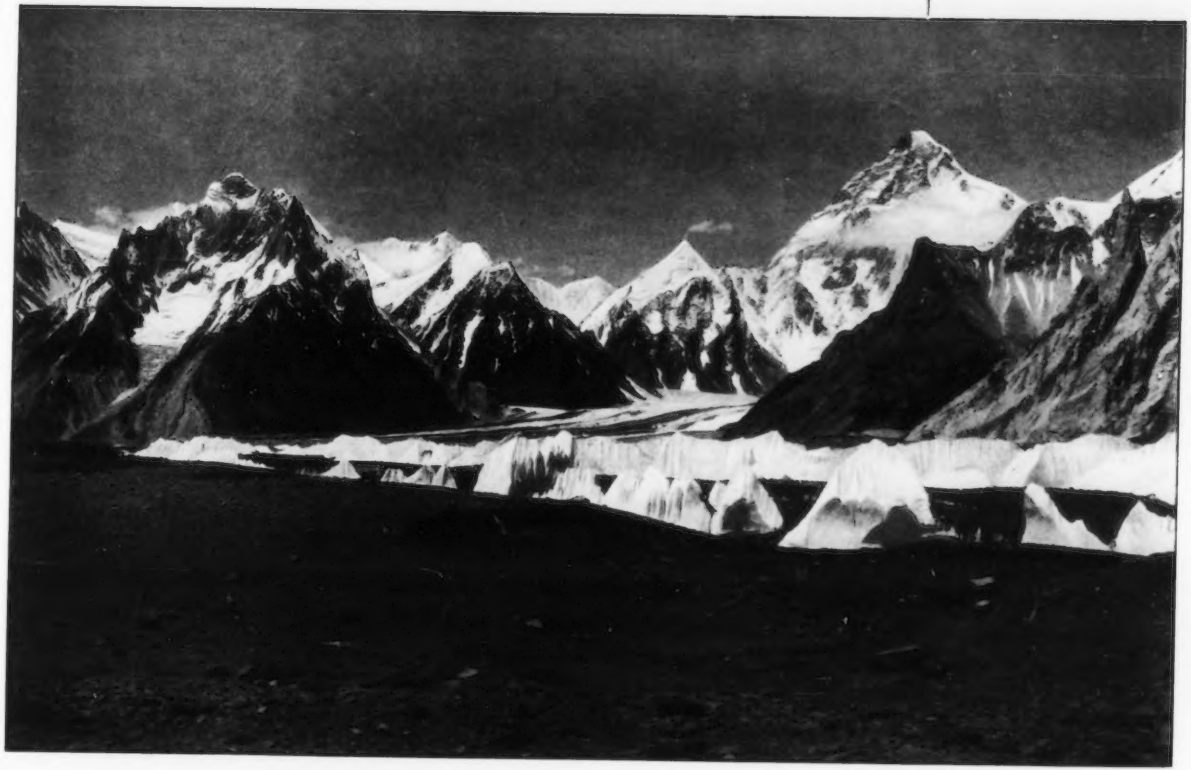
The Duke established his base camp upon an advanced spur of the left wall of the valley about 10 miles above the snout of the Baltoro. This spur is thickly clothed with shrubs, and is known as Rdokass. Mr. Baines, who remained here, was entrusted with the forwarding up of supplies, and with the reading of the instruments left behind to form a small meteorological station, comprising a mercurial barometer. Here Negrotto took angular measurements from the extremities of a measured base to a cairn built on the central moraine of the Baltoro, which measurements he repeated two months later on the return journey, and hereby established that the rate of motion of the centre of the glacier is on the average 5½ feet a day during the months of June and July. This is a considerable speed if we take into account the very slight grade of the slope. On a distance of 25 miles from the foot of the Gasherbrum range to the snout of the glacier the drop is 4550 feet. This gives an average inclination of less than 3½ per cent.

Later on, by a rare piece of luck, we were enabled to observe the rate of the upper Godwin Austen glacier. Some articles of equipment had been left behind by the Eckenstein-Wessely-Guillarmod expedition in one of their high camps in 1902. In the course of seven years these had been carried down less than a mile, giving an average daily rate of barely 2 feet—considerably less than that of the lower Baltoro, although the grade is much steeper.

Near Rdokass we began to notice on the glacier the strange pyramids of pure white ice which were first observed by Col. Godwin Austen in 1861. At this point they appear as isolated cones, from 10 to 20 feet high; next as sharp pinnacles; and at last higher up as huge blocks from 100 to 150 feet in height, shaped like irregular prisms and getting nearer and nearer together until they seem to be arranged in longitudinal rows. They may be remains of the high moraine-covered ridges which are found upon the glacier, and which Dr. Workman attributed, with apparent probability, to upheavals caused by the pressure of lateral affluents upon the glacier. I must confess, however, that I do not understand how these ridges should



THE UPPER BALTORO GLACIER.



THE JUNCTION OF THE GODWIN AUSTEN AND THE BALTORO GLACIERS.

have become so split across as to give rise to the formation of isolated pyramids.

On May 24 the expedition reached Concordia, the vast glacier amphitheatre where the Baltoro divides in two branches, one of which rises southward towards the Golden Throne and the Bride Peak, while the other, known as the Godwin Austen glacier, runs northward to the foot of K_2.

The exploration of the district round K_2 comprised a complete survey of a great glacier which is at the foot of the mountain to the west. From this glacier, by a somewhat difficult climb, the Duke reached a col on the watershed at the foot of the north-western ridge of K_2 (Savoia pass of the map, 21,870 feet), which afforded a view towards the north. The north wall of K_2 was, however, nearly entirely hidden by a large snow cornice.

The Duke had, on a later occasion, a better opportunity of observing this precipitous northern rock wall of K_2 from the great southern ice-ridge of Staircase peak, which he climbed to a height of 21,657 feet. From this point he was able to take a photographic panorama, which, together with those taken by Sella from the Windy Gap, serves to illustrate the region towards the east.

In the year 1889, Captain (now Colonel Sir F.) Younghusband went up from the Yarkand river to explore its tributary, the Oprang, to its glacier sources, which descend to the east of the Gusherbrums. From his account, compared with the only map then existing of the upper Godwin Austen glacier, namely, that published by Guillarmod,* the Duke expected to find the Oprang valley immediately to the east of Windy Gap. This, however, was not the case. At the foot of Windy Gap there flows down south-eastward a great glacier, bounded on the east by a chain containing peaks over 20,000 feet high. This chain appears from its direction to join the northern spurs of the Staircase peak. Beyond these mountains are visible the still higher peaks of another range, which might be the Aghil of Sir F. Younghusband.

From another col (Sella pass, 20,207 feet) on the left buttress of the upper Godwin Austen glacier, the Duke and Sella saw and photographed the ranges and the valleys to the east of the Gasherbrums. The whole of this distant region is dominated by a great peak which, after comparing the bearing taken by Sella, Dr. Longstaff identifies as Teram Kangri (27,610 feet), first measured by him just five days earlier. The glaciers which flow down from the eastern slopes of the Gasherbrums, and of the Broad peak, all meet in one great glacier, which may be the Gasherbrum glacier of Younghusband. There is no doubt that the topography of regions to the east and south-east of the Baltoro district is very intricate. The data collected by the expedition are insufficient as a basis for even such an approximate

* Dr. J. J. Guillarmod, 'Six Mois dans l'Himalaya.' W. Sandoz, Neuchatel.

sketch as might serve to connect our map with that portion of Sir F. Younghusband's which deals with the upper course of the Oprang river and with the glaciers to the east of the Gasherbrum peaks. Nor is it possible as yet even to sketch the chains and valleys which lie between the Godwin Austen glacier and the upper Siachen glacier (this latter explored and discovered by Dr. Longstaff), although they all appear in Sella's panorama.

Among the passes leading from the upper basin of the Godwin Austen glacier, the Sella pass alone seems possible to cross without excessive difficulty, so far as may be judged by looking down from above.

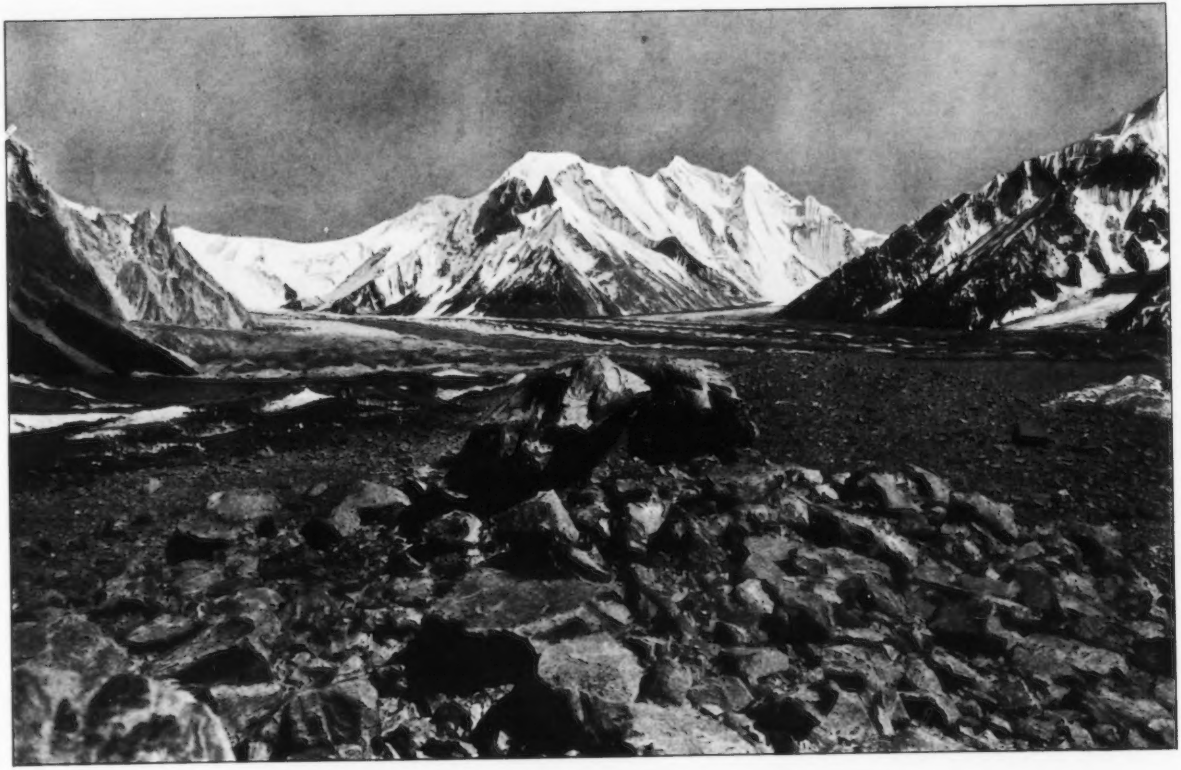
The Karakoram range does not seem likely to offer an opportunity of solving the problem of the highest altitude attainable by man. The greater portion of the chain looks absolutely inaccessible. The difficulties of the ice and the rock are in most places so great that not even European alpine porters could carry up a load without the help of fixed ropes. This prevents the establishment of high camps, and was the obstacle which frustrated the Duke's one attempt to ascend K_2 by the rocky south-eastern arête.

The exploration of the Godwin Austen glacier was completed by the end of June, and the Duke now decided to attempt reaching a great altitude upon some other peak of the same group. The only two which seemed possible were snow-peaks at the end of the upper branch of the Baltoro glacier, due south of K_2; namely, the Golden Throne and the Bride peak (Karakoram No. 8 of T.S. of India, 25,110 feet). The Duke's choice fell upon the latter, as being the highest and offering the additional advantage of having been trigonometrically fixed by the T.S. of India.

The weather had been very unsettled throughout June, with a nearly constant south-west wind blowing hard and cold on the ridges. In July the wind abated somewhat, but in its place came heavy snow-falls, often lasting for days together, while the sky was mainly overcast, and dense mists prevailed. In spite of these untoward atmospheric conditions, and of the deep soft snow, which considerably increased the fatigue of the ascent, the Duke succeeded in establishing a camp on the Chogolisa saddle (20,778 feet), between the Golden Throne and the Bride peak.

From this high camp he made two attempts to ascend the peak by its eastern ridge. After spending the night of the 11th at 21,673 feet, he started with the guides J. Petigax, H. and E. Brocherel, and reached 23,300 feet. A heavy storm forced him to come back. On July 17 he again camped at 22,483, and on the following morning, with the same guides, in spite of a dense mist, succeeded in reaching an altitude of 24,600 feet on the same ridge, a little over 500 feet below the summit. Here the party waited two hours in the vain hope

THE SNOUT OF THE BIAFO GLACIER.



THE BRIDE PEAK (KARAKORAM NO. 8 OF THE INDIAN SURVEY).

that the mists might lift. In view of the obvious risk involved in climbing a steep ridge fringed by a perilous cornice, without being able to see the way, the Duke was compelled to give up the attempt to reach the summit. The calculation of the altitude reached is based upon a barometric reading $12\frac{9}{32}$ inches referred to those taken on the same day at Skardu, Leh, Srinagar, and Gilgit.

I will not here dwell at length upon the physiological effects of great heights as experienced by the expedition. Suffice it to say that no acute phenomenon of mountain sickness occurred. The Duke and five guides spent nine days at and over 21,000 feet, without experiencing insomnia or any other unpleasant symptom. As far as 24,600 feet the pace, although slow, may keep tolerably steady, even in soft deep snow and on rather steep slopes, the only symptom recorded being shortness of breath, and a slight increase in the pulse.

The experience of the expedition is by no means discouraging to the prospect that one day some of the highest peaks may be climbed. But it is essential to success that the mountain should be an easy one, and not of such a nature as to involve exceptional ice or rock work, which would render it impossible to carry up the necessary equipment.

The adverse weather which had prevailed for three weeks almost without interruption showed that the worst period of the monsoon had begun, nor was there the least hope of improvement in the immediate future. The Duke therefore decided to return. On July 24 the expedition left the Baltoro glacier, and reached Askoley on the 27th. Hence, by the shorter summer route over the Skoro-La, and the Deosai plains, we reached Srinagar in a fortnight.

The survey work was carried out by Lieut. Negrotto. The system used was Paganini's photogrammetry, supplemented by theodolite mensuration. In addition, mercurial Fortin barometers, aneroids, and hypsometers were used to determine various heights. These heights were calculated with reference to the base station Rdokass, on a spur of the south or left buttress of the Baltoro glacier. The altitude of Rdokass (13,205 feet) was ascertained by observations taken three times a day during two months, compared with the readings of the observatories of Skardu, Leh, Srinagar and Gilgit.

The result of the survey is a map which comprises the upper basin of the Baltoro glacier, the whole of the Godwin Austen glacier, with its tributaries, which encircle three-fourths of K_2, and the mountain chains which enclose them. This map shows that the configuration of the district differs widely from that given in the map of the Anglo-Austro-Swiss Expedition, published by Dr. J. J. Guillarmod. A number of new altitudes are given on the map. Of these the most important is the one which assigns to the Broad peak an altitude of 27,133 feet. This altitude, added to that of Teram Kangri (27,610 feet), at the head of the Siachen glacier, brings up to seven the number of peaks now known

to be above 27,000 feet. The other five are Mount Everest, K_2, the two peaks of Kanchenjunga, and Makalu.

The experience of this journey agrees with that of the Ruwenzori expedition in showing that the aneroid barometer is too delicate an instrument for mountain expeditions, and must be regarded as quite untrustworthy. It can only be useful as an instrument of comparison. In spite of every precaution a discrepancy resulted at certain points between altimetric figures derived from the reading of pressure and those obtained by intersection. Rather than take a mean it is for the present advisable to retain both data until further observations may be forthcoming.

This was the first time that the photogrammetric method had been tried on an exploring expedition of such a nature. The result has been very satisfactory. The method is very useful for survey work in bad climates with changeable weather because it is rapid. A panorama may be made in less than an hour. There is no possibility of errors in reading; all the calculations are made after returning home, and the plates give an absolute test of the accuracy of the work, and remain as a permanent document. The only drawback is the necessity of carrying glass plates, which are fragile and heavier than films.

As on his former expeditions, the Duke took regular meteorological observations three times a day during the entire campaign. The experience of a single season is not conclusive as regards climate; nevertheless the data will be useful in the future in comparison with further observations. During the whole of June the wind blew steadily from the south-west and at a great height. The nights were cold and the days not excessively warm. In July the violence of the wind diminished considerably, and the temperature rose, but heavy snow-falls began. There is every reason to believe the the high regions of the Karakoram have a climate of their own which differ from that of the lower valleys notwithstanding the shortness of distance as the crow flies. Our experience confirms the observation recorded by our predecessors as to the absence of all electric phenomena in the atmosphere.

About July 20, at Footstool Camp (about 16,600 feet altitude) the snow began to turn into heavy rainfall.

The expedition has recorded that the great chain of mountains comprising the Broad peak, the four Gasherbrums and the Golden Throne is composed of limestone and sedimentary rocks; whereas the opposite ranges, comprising the Staircase peak, K_2, and Bride peak consist of crystalline rocks. A small detached portion of the limestone formation forms the peak of white rock on the corner of the Baltoro and Godwin Austen glaciers. In a recent article Col. Godwin Austen has compared this double formation of the Baltoro and the Godwin Austen valleys with that recorded by Dr. Neve and Dr. Longstaff in the Siachen valley, which has also a south wall of granite and a north wall of stratified

rocks, of which north wall Teram Kangri forms a part. According to Dr. Longstaff and Dr. Neve, the chains formed by sedimentary rocks may even be considered as a separate system which constitutes a northern Karakoram range corresponding to the second Hindu Kush range.

The specimens of plants brought back by the expedition are now being studied, and go to confirm the resemblance which has already been recorded between this flora and the mountain flora of the other great Asiatic ranges, and of the chief European ranges, including the Alps.

The Expedition are unanimous in their high praise of the Baltis, whom they found docile, willing, easy to persuade, extraordinarily sober and always good-humoured. Thirty-five of them lived with us upon the Baltoro, of whom fifteen were our constant companions in the high camps. They even went up to the Chogolisa saddle. They acquired a perfect knowledge of the use of the rope on the high glaciers, which were full of crevasses and covered with dangerous snow, and they possess all the necessary qualities to become first-rate Alpine porters in a few seasons.

The Chairman (Mr. Yates Thompson), before the paper, alluding to the circumstance that the lecturer was an Italian, and that the Italian Ambassador was present, remarked that all people were perhaps not aware how much geography owed to Italy. It was, however, an Italian who first discovered the whole of Central and Eastern Asia; it was an Italian, Christopher Columbus, who discovered America; and now we had an Italian gentleman who, in the cause of geographical science, had penetrated to the most remote regions of Asia—regions which Cæsar never knew—and who would doubtless give us an excellent account of what he had seen.

Mr. Yates Thompson (Chairman), after the paper: We have all been greatly delighted with the lecture of Dr. Filippi, and we only wish that the Duke had been here who commanded this expedition, and who is a Duke, for his energy, his industry, and his vigour, who might almost meet the requirements of the Chancellor of the Exchequer. What is most remarkable about this lecture and this region is, that we have here the last explorer of it, and we have also the first, Colonel Godwin Austen, whose name is connected ever since the year 1861 with this remarkable, this terrific region, and I hope he will let us hear his view of the achievement of the most recent explorer of the regions he first visited.

Colonel Godwin Austen: The first diagram we saw on the screen gave the route of His Royal Highness the Duke of the Abruzzi from Rawulpindi to the Baltoro glacier on the Karakoram range. It gives me the opportunity, which is fitting, to bring to your notice the names of two officers who, as far back as the early fifties, were associated in mapping that part of India. Those officers were Captain D. G. Robinson and Captain T. G. Montgomerie, of the Bengal Engineers; they organized the survey parties, and we owe all the geography to them. The work that was done near Rawulpindi, in the Sind Sagor Doab lying between the Jhelum and the Indus, was a fine piece of surveying work from the excellence of its topography. The work that was done by Captain Montgomerie

was the region from the plains of the Punjab up to the main range of the Himalayas. That survey is perhaps one of the most accurate, as far as its triangulation goes, as any that was ever done, and particularly for the very lofty peaks on which observations were taken. The most rigorous observations were taken close up to the main range which we have seen depicted this evening. As the triangulation and topography advanced from the plains into Kashmir and on beyond, the great ambition which we had was to reach the snowy peaks which we had seen looming far away for several years. They were fixed so accurately that when the plane-tabling work had to be done, it was comparatively easy to do it. A great work is before some future surveyor in carrying the survey further to the north. A fine attempt was made by Dr. Longstaff in proceeding up the Saltoro glacier, and the work that has been done by the Duke of the Abruzzi is of a similar nature. It is a great pleasure to me, who took part in the survey operations, to find that surveyors are penetrating into a portion that we were unable to reach, and that there is every possibility of their proceeding on beyond the range of the Himalayas and mapping a great deal of the country, of which at present we know very little. There are many points in the address we have had this evening that would form a lecture alone, and it is almost impossible to touch upon questions of geology; but I was struck with one point, in two or three of the diagrams which we have seen thrown upon the screen. The summit of K_2 appears to me to be of a more recent rock than that of the base, and it is not at all unlikely that the summit may prove to be of stratified rocks, while the base is of granite, which the Duke has recorded. It is very interesting to find the allusion to the limestone and stratified rocks which occur at the head of the Baltoro glacier—it leads us to connect that portion of the range with what was observed by Dr. Longstaff to the east, and what I have seen myself on the Changcheumo and Pankong lake still further to the eastward. I think that the work that was performed by the Duke of the Abruzzi and those with him in remaining upon the Chogolisa plateau for ten days was a most extraordinary feat, and every credit is due to them for the exposure that they underwent on it.

Sir Francis Younghusband: I think we must all admire both the great energy, daring, and skill, with which His Royal Highness the Duke of the Abruzzi led this expedition, and the thoroughness of the scientific work. But as geographers I think we must all admire, quite as much as the thoroughness, his reserve. I dare say you noticed on the right hand corner of the map a great blank space; although His Royal Highness had seen peaks there, he had seen enough of these mountains to know that you cannot trust a mountain a yard further than you can see it. Upon every side it presents a different aspect. Some twenty-four years ago, when I stood before this Society and described my journey across these mountains, which I first saw from the northern side—the side directly opposite to that from which His Royal Highness's expedition has been working—I said that this great range on the northern side looked to me as if it was made up of a series like one hundred Matterhorns in a row. It was an exaggeration; still, I think after you have seen these magnificent photographs, which I think we must all admit are the finest series of mountain photographs which have ever been presented to us, you will agree that if I was wrong in saying that there was one hundred Matterhorns, at any rate, that was the best means I could possibly employ of producing upon your minds, without these beautiful photographs, an impression of the grandeur of the mountain region. After seeing those photographs, you will be able to realize what my feelings were, when, without any Alpine guides, without any Alpine appliances, without tents

even, I had to find my way right through those mountains into India. But, fortunately for me, I had to get across the very easiest point, and not like His Royal Highness, aspire to climb the very highest peak.

Dr. de Filippi and Colonel Godwin Austen have dwelt upon the importance of prolonging the explorations which have been already undertaken by His Royal Highness and Dr. Longstaff, and filling up that extremely interesting and important gap which lies beyond what has already been done, between that and the valley of the Oprang river. When we discussed these points together, previous to his Royal Highness proceeding to these parts, I was fully under the impression that when he reached the watershed, at what we then thought would be Windy gap, which I dare say you noticed at the extreme right of the map, the party would then look down into the Oprang river. But I think, probably from the geographical point of view, the most important result which has come from this expedition is the fact that between there is another valley and another high range; it would be of interest to explore the northern slopes of this magnificent mountain, Teram Kangri, discovered by Dr. Longstaff, and which in all likelihood will prove to be even higher than the height he attributes to it at present, 27,000 feet. I think that is the chief piece of exploration to be done in the region, and much as I admire Italian enterprise, I hope English enterprise won't be behind in carrying it out. We all owe a deep debt of gratitude to his Royal Highness for permitting Dr. de Filippi to give us this lecture, and to show us those splendid photographs, which have been taken with infinite care by Vittoria Sella; and I should like to thank Dr. de Filippi, and to express my admiration for the excellent way in which he has lectured to us, in what is to him a foreign language.

Sir Martin Conway: I think one of the most revealing photographs that was shown upon the screen to-night was the first photograph—of the map. It would be difficult to find a piece of the world anywhere that would show you such an extremely intricate tangle of mountains as that portion of the map shows. There is, I think, no part of the world where mountains throng together, and finally uplift themselves into so astounding a group of super-eminent peaks, as do the mountains that surround this knot-point of the ranges of Asia. The mountains that surround the head of the Baltoro glacier—I think you will admit, after seeing, as you have, the wonderful photographs of them shown to-night—yield to none that any of us have ever seen, in precipitance, in boldness of form, in loftiness, and in the way in which they are grouped together. They are beyond question the finest mountain group in the world. When I went up that region, now eighteen years ago, it was with the hope that we should find there a high mountain that we could climb, and I cannot describe to you how, as day after day passed and we got further and further into the heart of these mountains, the feeling of hopelessness overwhelmed us—hopelessness of ever finding anything we could climb at all. Because in the case of most of these mountains it is not merely impossible to reach the summit, it is difficult even to commence the ascent from the bottom. There are no peaks I have ever seen that are more inaccessible than the bulk of the peaks that surround the Baltoro glacier, regarded even from the most expert rock-climber's point of view. If anything is to be done in climbing in such a district as this, it is necessary that the climbing party should be exceedingly well equipped, exceedingly well organized, and exceedingly well supported by a large body of porters. To organize an expedition which shall be able to carry into the front line—what I may call the "fighting line"—a sufficient body of expert mountaineers, to organize an expedition of that kind,

with its quantity of coolies, its huge organization, and then to lead that expedition to the highest point that has ever been reached by man, is indeed a great achievement. That was the achievement of the Duke of the Abruzzi. I have no doubt that in the future another expedition, not only one other, but many others, will go up this same Baltoro glacier, and will attempt again either the Bride peak or the Golden Throne, or possibly one or two more which may conceivably be climable among these mountains; but I cannot believe that any expedition will be better led, better organized, or more successfully brought back. The Balti coolies, upon whom ultimately the success of the expedition depends, are very docile men, but they require much care and a great deal of attention, or they would be very easily lost. I think that the fact that this expedition has returned after employing some three hundred of these men, taking them right into the very fastness of the mountains, and bringing them safely back, is one we should take note of. It would be easy to talk at great length about this district, but I will confine myself now merely to expressing my hearty congratulations alike to the leader of the expedition and to his followers, and our thanks to Dr. Filippi for the extremely interesting manner in which he has described the journey to us to-night.

Dr. T. G. Longstaff: I have not myself been on the Baltoro glacier, although last summer I was, Asiaticly speaking, fairly close to my friend Dr. de Filippi; I was then on the glaciers further to the south and east. If I attempted to take up the many interesting points that are raised in Dr. de Filippi's paper, I am afraid the hall would be empty before I was half through. I should like, however, to draw attention to one thing, about which, with characteristic modesty, very little has been said, and that is, that Broad peak has been for the first time measured, and turns out to be over 27,000 feet. Now, 27,000 feet is a peculiarly interesting orographical number. You have the twin peaks of Kanchenjunga, 28,000 and 27,000; you have Everest and its companion peak, Makalu, 29,000 and 27,000, and now we have K_2 and Broad peak, 28,000 and 27,000. Those are the only three groups in the world that are definitely known to attain such an extraordinary altitude. There are no others besides those five mountains, with the possible exception of Teram Kangri, whose height cannot as yet be definitely accepted; so that really this addition of a fifth peak is a very important one indeed. With regard to the excellent survey of Lieut. Marchese Negrotto, it was carried out by Paganini's photogrammetric method, of which you hear very little in this country; I do not quite know why. The method was started in 1849 by Colonel Laussedat, in France, and since then it has been steadily improved. It was introduced into Canada by Dr. Deville, and has been exclusively used by Wheeler and Drewry and other eminent Canadian surveyors in the Rocky mountains. It is an extremely accurate method of survey, and I do not think there is any other which is so suited to a mountain country. Mountaineers must have listened to this lecture and seen these photographs—the most beautiful photographs Sella has ever produced—with a certain amount of regret; all the mountaineers I have met who have much experience practically give up hopes of being able to do any very high climbs in the Karakoram. There does not appear to me to be the slightest chance of success. I have no doubt expeditions will continue to attempt K_2. I was myself asked last January to join a man to go out to K_2. He assured me it was perfectly easy, so I suggested that he had better do it himself. I was of course exceedingly interested when Sella came to develop his photographs, to hear from him he had found Teram Kangri, a big peak to the south-east which I had seen and measured in the same year,

because there is some doubt about my measurements, and all the summer I have been wondering whether the peak really does exist; so it is a matter of great gratification to me to see it in that panorama. Sella took it on June 22. I crossed the Saltoro pass with Neve and Slingsby on June 15, and, I think, made my first measurement of Teram Kangri on the 17th, so I just managed to get it in by five days. At any rate, I think we may be certain that a very high mountain does exist in the position I indicated.

About that final climb of the Duke's. Dr. de Filippi, and his companions also, have such a rare habit of modesty, that I do not know whether you quite realise what a very remarkable feat that final climb of the Duke's was. The bare idea of camping at over 21,000 feet for ten days is perfectly horrible to anybody who has ever done anything like it. It is appalling to think of; and then at the end of that time, having got to 24,600 feet, to wait for two hours for the weather to clear and make the last 500 feet of corniced snow-ridge possible. To go on was merely to court the disasters that have made the Lyskamm so notorious in the Alps; it is a danger that no sane mountaineer would dream of encountering. It is exceedingly hard lines, when complete success was almost in his grasp, that he was not able to complete the ascent. Naval officers are admittedly very accurate observers; the altitudes were deduced by mercurial barometer, checked at Leh, Srinagar, Skardu, and Gilgit; also they had their own base station at Rdokass. So this ascent to 24,600 feet is absolutely certain and definite beyond all doubt, and is much the highest ascent that has ever been made, or that any one else has ever claimed to have made.

Dr. STEIN: It is a somewhat unexpected honour that I find myself called upon to speak after the eminent mountaineers who have given you their high appreciation of this wonderful expedition of His Royal Highness. But I cannot deny the fact that I have passed the Karakoram, both west and east, on scientific expeditions, and that long ago I had also the good fortune, on what I may call a mere holiday trip, to sight Mount Godwin Austen or K_2. It was after my first year in India, after a Punjab "hot weather," during which one felt half roasted and half boiled by the heat of the plains, that I made up my mind to get as near as I could to the greenest spot on the Indian maps, green being the colour used in them for glaciers, and there is certainly no spot anywhere in the mountain regions of Asia where that colour occupies a larger space than about K_2. It was a short holiday: I just managed to get near the foot of the Baltoro glacier and back again in time without exceeding my leave. But ever since, the vision I had of that wonderful mountain has been a cherished possession to me. I am not qualified, from such an acquaintance as I have got of Mount Godwin Austen, to speak about the physical conditions of that region. But certain points which Dr. de Filippi mentioned at the beginning of his paper encourage me to make a remark or two as to historical facts concerning it. We humans have a way of intruding into the mountain world, even where it is "horrible," as Dr. Longstaff has called it. Thus there is the broad fact that this Baltoro glacier has seen regular trade during centuries, and in periods which by no means go back to dim antiquity. We have the evidence of one of the most observant visitors the East has ever seen, Dr. François Bernier, who went to Kashmir during the reign of the Moghul Emperor Aurangzeb. He records how, the Ladak route being closed by war, the trade between Kashgar and Kashmir was carried on over that high Muztagh pass, which again centuries later Sir Francis Younghusband crossed twenty-four years ago as the first European. I also might mention that the important observation of Dr. de Filippi's regarding the racial origin of the Baltis is entirely confirmed by early

Chinese records, which tell us that Baltistan, known to them as Great Po-lu (Bolor), as well as Gilgit, were occupied by the Tibetans in the eighth century A.D. I have no doubt that the prevalence of Tibetan speech is largely due to that prolonged occupation.

A nearer past and nearer historical links must rise to our minds here. I think it a truly memorable occasion, when we have present here the first explorer of that great region, Colonel Godwin Austen, after whom the mountain was named, rightly as I believe, by a former President of this Society. Since his days many expeditions have gone up to the great peaks of the Himalayas; but I think that none of them has done more remarkable pioneering work than Sir Francis Younghusband when he came down without guides, without a camp, over that glacier pass disused for centuries. It is also no ordinary occasion when we can hear Sir Martin Conway, who led the first large mountaineering expedition to these parts, and Dr. Longstaff, whose recent explorations have opened out a new region to us east of that great peak. We have here also the linking of the past with the future; because I have no doubt whatever that unexplored region to the east of Mount Godwin Austen will attract many an expedition yet to come. However, I believe that none of them could possibly exceed in daring, in leadership, and in organization, the one which Dr. de Filippi has described to us, and which H.R.H. the Duke of the Abruzzi led. I have had my humble experiences of work in mountains which are deserts too. I have been obliged to move large parties across high mountain regions where for forty or fifty days nothing in the way of food could be secured, and it is the practical knowledge of the difficulties involved which fills me with the highest admiration for the organization, care, and skill with which this prolonged exploration was carried out. We have received here, as it were, personal evidence of H.R.H.'s skill in organization. I am sure he could not have entrusted the task of acquainting us with the results to anybody more qualified than Dr. de Filippi. He told us at the beginning that he had no adventures to relate. He wisely allowed nature and the peaks which we saw before us to speak. No words on my part could possibly add to the appreciation which Cav. Sella's slides must have excited in all of you. I only wish to add my own personal gratitude for having been allowed to see Mount Godwin Austen again in such marvellous photographs, and my thorough admiration for the way in which the expedition's work was related.

Dr. DE FILIPPI: I can make no reply to everybody who has so kindly spoken, except my thanks. I think the weighty authority of Colonel Godwin Austen, Sir Francis Younghusband, Sir Martin Conway, Dr. Longstaff, and Dr. Stein have contributed to convince you that although the chief aim of the expedition was mountaineering, still H.R.H. the Duke of the Abruzzi has given it every chance of doing whatever geographical and scientific work might prove possible. I beg you to accept my warmest thanks for the indulgence you have shown to so dry and technical a paper. It would please Sella to know how keenly appreciative you have shown yourselves of his work. I shall be proud to convey to H.R.H. the Duke of the Abruzzi the warmth of the reception which you have accorded to the narrative of his journey and your appreciation of his labours. I know I interpret his wishes correctly, in thanking you heartily on his behalf.

SOME CONTRIBUTIONS TO THE PHYSIOGRAPHY AND HYDROGRAPHY OF NORTH-EAST BORNEO.*

By I. A. STIGAND.

In consideration of the comparatively little-known physiographical conditions in these parts of Borneo, the following contributions may be worthy of record. On the east coast, more especially, the physiographic associations of the rivers, together with the evidences which they display of former secular movements, present many interesting features, while records also exist of movements of a more rapid character. As the regions described have to be approached from the east coast, it is necessary to start, as it were, from the wrong end, the observations proceeding from the mouths of the rivers towards the interior. The district principally dealt with lies in the vicinity of the boundary between Dutch and British North Borneo on the east side, and is bounded, for the most part, by that long length of coast designated Sibuku or St. Lucia bay.

Commencing to the south of Sibuku bay, the coastal regions consist of an immense area of deltaic deposits—the combined products of the Sambakong and Sibuku rivers. The former river is one of the largest, with reference to its drainage area, in the northern portion of Borneo. The northern main branch of this river, or upper Sambakong, which flows down from the north, its basin expanding with an immense system of tributaries towards the north-west, drains a large portion—perhaps 2500 square miles—of South Central British North Borneo. On the west its basin extends to that of the Kinnabatangan and the upper tributaries of this river, while its north-western tributaries flow down from the watershed of the Padas and extend to no great distance from Tenom, which is on the railway from the west coast. Could boats be obtained on these upper sources, navigable portions of which are within comparatively easy access from Tenom, the transit of North Borneo from Brunei bay, by means of the Sambakong river, would not be a very difficult undertaking.

Continuing northwards, the next river is the Sibuku, the delta of which merges, with numerous ramifications, into that of the Sambakong river, and on the other side into the alluvial deposits of the Simmenggaris river. After at first trending in a westerly direction for some distance, the Sibuko also turns to the north—towards British North Borneo territory; its upper waters running parallel with the upper Sambakong on the west. This northerly trend is also taken by the principal tributaries of the next river—the Simmenggaris—also flowing into the sea in Dutch territory, some of the sources of which flow down from British North Borneo.

This hydrographic feature of these rivers, whereby the waterflow of a considerable portion of South Central British North Borneo is discharged through Dutch territory, has a not unimportant political significance, inasmuch as jungle produce (viz. rubber, rotan, resin, etc.) gathered in this British area, and transported by means of these rivers, is collected

* Map, p. 128.

in Dutch Borneo. Although this is chiefly apparent in the case of the Sambakong, as the navigable portions of the Sibuku and Simmenggaris and their tributaries do not extend very far into British North Borneo, upper sources of these rivers proceed extensively into British North Borneo territory; moreover, the upper unnavigable parts of rivers and streams invariably form the routes for native paths into the interior connected with the farthest limits practicable for canoes.

To return to the Sibuku river, there are two principal mouths of this river—the Rooverstrek or Boekot river, flowing east and joining the sea not far from the mouth of the Sambakong; and the proper mouth of the Sibuku, flowing north-north-east, joining with the estuary of the Simmenggaris. The whole of the coastal region between the Sambakong and the Sibuku proper is composed of deltaic flats divided up by innumerable trusans or channels.

At the mouth of the Sibuku (Fig. 1), there is an island, composed of two hills joined by an alluvial tract—Tenelek I. (Fig. 2). The hill on the north-north-east extremity of the island is over 100 feet in height and bears evidence of being a remarkable recent upheaval, and remains of marine organisms which are denizens of the sea at the present day are found on the summit; moreover, it exhibits a peculiar geological structure. This will be described in more detail in the sequel. The other hill on this island is a little higher and in shape suggestive of a volcanic cone. No exposures of rock could be found on its flanks, but outcrops of indurated strata occur on the shore in the vicinity. On the summit there is a pool always containing water. No recent marine remains were found on this hill.

On either side of the Sibuku mouth, other small isolated hills occur, many of a roughly conical form, as islands scattered in the alluvial sea. To the north-west of "New Hill" in the estuary of the Simmenggaris, occurs a very small island, composed of rock having a similar appearance to that of which "New Hill," is composed. It is called Plandok island, presumably on account of its smallness (Plandok—Malay = mouse deer).

At a distance of some hours' paddling up the Sibuku is situated the Tidung village, designated by the same name as the river. On either side of the river, on the way to the village, other small hills occur. At the time of full moon, the Sibuku river is remarkable for having a bore. The advance of the wave up the river can be heard at some distance, thus offering a timely warning to the occupants of canoes.

We next come to the Simmenggaris river. Proceeding up the estuary, four commanding mountains are visible towards the west-north-west, and in the region of the sources of this river and of the Serudang. These mountains are, proceeding from north to south, named Blancus, Bukit Raya, Lobang Bakus (Lobang—Malay = hole, Bakus—Tidung dialect = pig), and Batu Maya.

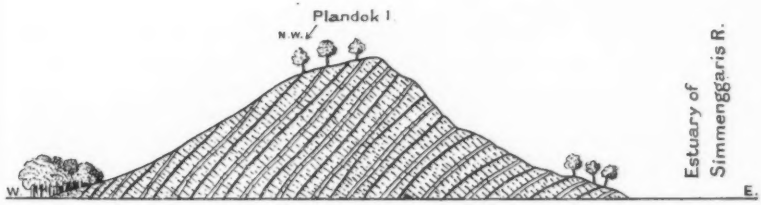
On the south of the estuary of the Simmenggaris, there enters another river—the Sibakis—beyond the Sibuku, which drains a comparatively

small yet considerable area between the lower Simmenggaris and Sibuku rivers, and entering the estuary of the Simmenggaris by a subsidiary estuary running north-north-east beyond which the river trends east towards the interior.

On the north side, after passing various delta arms, we come to the Kanduangan river: the estuarine channel of this river, after first trending north, turns at right angles, running east and west, and the channel receives three small rivers coming from the north, the first, named Kanduangan Kechil (Kechil—Malay = small), joining the channel at the bend, the other two, after joining, at the eastern extremity of the channel. These three small rivers or streams receive the drainage of

Mouth of Sibuku with Tenelek I.
(New Hill in foreground)

FIG. 1.



Profile of "New Hill" – Tenelek I.
Mouth of Sibuku River.

FIG. 2.

the greater portion of the country, consisting of hill lands, which lies between this part and the lower Serudang river. As will be seen, when we come to observe that river, the watershed in this area is situated comparatively close to the Serudang which runs in a narrow valley lying at some distance to the north of the boundary. In the Kanduangan the tidal limit is very high, proceeding some distance up its smaller tributaries, and it is, for the most part, a river of deposition.

The next tributary of the Simmenggaris is one that drains a large tract of country to the north-west, named the Seklean. Entering the Simmenggaris from the north and then bending towards the west, it trends on the whole north-west, flowing intermediate between the basins of the Serudang and the Semaja—a higher tributary of the Simmenggaris. Beyond, the Simmenggaris bends to the north (another tributary coming in from the west), but further on continues in a west-north-west direction,

until, at a distance of about 15 miles from the estuary, opposite the site of a deserted village, the Semaja river comes in from the north-north-east, although the average trend of this tributary is north-west. The Semaja takes its sources in British North Borneo, its upper basin adjoining the watershed of the basins of the Sui Sui—a south-west tributary of the Serudang—and the Tambulunan rivers, to the north. Coming down from this watershed, in a succession of cascades and rapids, and passing between the Seklian and Serudang river, it at length assumes a sinuous and less erosive form as it nears the Simmenggaris. At a short distance from its junction the Semaja receives a small river from the north, named the Jilompon, which receives a large part of the drainage from the watershed between the Semaja and the Seklean rivers. This watershed consists of a lofty range of hills, as also does that between the Seklean and the upper Serudang and Tambulunan rivers.

A few more windings of the Simmenggaris bring us to a Tidung village, situated within a pronounced sinuosity of the river which is fast developing into a "cut off." This village is known as the Semaja Kampong (Kampong—Malay = village) on account of it having originally been situated in the Semaja river. The chief of this village, having originally come, with his followers, from the Serudang, first settled about one and a half mile up the Semaja river, and then migrated to a position on the south bank of the Simmenggaris, opposite its junction with the Semaja, where the remnants of the dwellings can still be seen, before finally settling in the present position.

Beyond this village the Simmenggaris trends in an average west-north-west direction, flowing in a comparatively narrow valley, and becoming more erosive in its nature, although its tidal limit lies far beyond the village. Its basin is, for the most part, narrow, numerous small tributaries descending in cascades on either side, although there are a few fair-sized tributary streams, one of which, entering the main river from the south at a distance of about one hour's paddling above the village, is the Simmenggaris, the main river being known above this tributary as the Loesan. This curious application of the name of a larger river to one of its smaller tributaries is not an uncommon practice in these parts of Borneo, and exactly the same occurs in the case of the Serudang, the internal portion of which river is known as the Tambulunan above the junction of a small tributary from the south designated the Serudang.

The Loesan trends north-north-west to north-west, extending for a considerable distance towards the interior, where it descends in numerous rapids and cascades. There are habitations of Ulu Dusans and Tengaluns in the neighbourhood of its upper waters.

The formation in all this region consists of a series of sandstones, sandy shales, and shales containing numerous coal-seams, belonging to a low division of the Tertiary, generally dipping gently towards the south. This formation extends to the north rising in several monoclinal folds

between the Simmenggaris and the Serudang, the horizons thus becoming lower as the latter river is approached from the former. There are numerous outcrops of coal in the region of the upper Simmenggaris, as also in the intermediate district between the latter river and the Serudang, many being of very fair quality and in seams of workable thickness. In the region of the lower parts and estuary of the Simmenggaris a more recent formation fills the basin, laid unconformably on the older Tertiary; in the vicinity of the Kanduangan river, this newer formation extends north as far as the boundary.

From the mouth of the Simmenggaris, the alluvium of the Simmenggaris delta—including an island named East Nonuekan—gradually narrows to a strip bordering the coast and hill lands between the Simmenggaris and Serudang rivers, which in turn gradually merges into the huge compound delta which is the combined product of the Serudang, Silompopon, and the Kalabakang rivers, and which extends as far as the north of Cowie harbour and is traversed by almost innumerable trusans or channels.

On account of the hydrographic feature to which reference has already been made, viz. that these large rivers flowing into the sea south of the boundary, with their tributaries, trend towards the north, the higher lands come nearer the coast in the region which is now approached, and there is thus more of physiographic interest to the observer from the east coast.

The Serudang and Silompopon rivers, at a short distance below their convergence, flow into a trusan or channel joining the two delta mouths, which are named respectively the Soadan and Solan.

A few windings of the Serudang, above its confluence with the Silompopon, bring one to a Tidung village of the same name. Above this the Serudang is a typical river of erosion. Its basin is relatively narrow, the watershed between it and the Simmenggaris being close to the Serudang, its lateral drainage being chiefly conducted in small streams which flow down in cascades into the Serudang. The basin, however, gradually expands towards the interior, where, dividing up into fair-sized tributaries, notably the Sui Sui and Tambulunan rivers, it drains a considerable area. The tidal limit in this river is situated at a distance of about 5 or 6 miles above the village. The valley in these parts is comparatively narrow, high hills rising on either side. At low tide there are rapids in the course of the river below the tidal limit. At this tidal limit the river falls over a hard bed of grit. Flowing over this hard stratum in a narrow and deep channel, the whole of the river is precipitated in considerable volume and force into a seething pool below, where the current, whirling round at low tide, has worn a deep recess in the sandstone outcrop on the right bank.

The Serudang passes along strata consisting for the most part of nearly horizontal sandstones, of various grades of induration, the harder ferruginous grits forming the waterfalls, rapids, etc. The strata, however, have on the whole, a gentle south-south-west dip, and, between the

Serudang and Simmenggaris rivers, descend in a monoclinal fold, below which they are overlaid by the newer formation filling the lower basin of the Simmenggaris, and consisting of fluvatile deposits of white clay, sands, and shingle beds. Above this waterfall at the tidal limit the river-bed rapidly rises, passing over a succession of rapids over the harder strata, and rushing through gullies, for some miles inland. Above this strongly erosive portion of the river, which affords some fine scenery, the river again assumes a more placid aspect, passing on in many meanders for many miles towards the interior, and in these parts would be navigable even for small launches, were it not for occasional fallen tree-trunks. It is joined by two principal tributaries from the north, the Serom (coming in from the north-north-west) and the Serudang, the latter—a comparatively small tributary—as in the case of the Simmenggaris, taking the name of the main river.

Near the confluence of the small Serudang is situated a small settlement of Ulu Dusans, a primitive, but friendly tribe.

Beyond the junction the main river is known as the Tambulunan, and again becomes strongly erosive, rising to a considerable altitude over impassable rapids, until its convergence with the Sui Sui river. Here it bends round to a northerly direction, while the Sui Sui trends to the south-west. From their junction both rivers become navigable for native canoes. Further on the Sui Sui again becomes turbulent, splitting up, of course, into numerous tributaries, which take their rise in the watersheds with the Semaja and Sibuku rivers; while the Tambulunan river, also becoming of a strongly erosive form in its upper parts, flows down in rapids and cascades from the north.

Between the Serudang tributary and the Serom river rises a prominent elevation, known as Tidung Allah (Tidong—Tidung dialect = mountain; Allah—Malay = god). Its summit consists of a dip slope and escarpment, dipping gently towards the south-west. This may be the mythical Mount Creagh,* marked on the maps, but this name appears to be a very doubtful one.

We now come to consider the Silompopon river which, as mentioned above, converges with the Serudang river in the delta regions, flowing down from the north-west. Its tidal limit is situated about 10 miles up the river, near the coal-mines which are worked in the vicinity of this river. From the delta to here it may be denoted as being a river of deposition, although small spurs in some places come down to the river and are to a small extent eroded. At the tidal limit there is a steep rapid or waterfall over hard ferruginous grits and for some distance beyond the river is principally one of erosion, flowing over a succession of these hard grit outcrops, which give rise to rapids and waterfalls. The coal-seam which is being worked outcrops in this region.

Above, a few miles north-west of the mines, the river, although smaller,

* Cf. general map of British North Borneo.

again becomes one of deposition, flowing through a plateau and here splitting up into many tributary branches sluggishly flowing in sinuous courses over the plateau, which is, doubtless, the product of deposition from the erosion of the high hills to the west and north of the mines. These hills include the range seen from the Kalabakang river on the right bank, which forms the watershed between the two rivers, and also a long and lofty ridge, having the aspect of a sierra, caused by alternations of escarpments and dip slopes along the summit—which can be seen towards the interior. Beyond the plateau, the ground gradually rises until spurs are met with ramifying from the high hill system, to which reference has above been made. Here, in the higher altitudes, the numerous streams and torrents constituting the sources of the Silompopon again display erosive action.

The formation in the Silompopon basin consists of a similar Tertiary system, generally dipping gently towards the south, and extending as far as the Kalabakang, which is the next river to consider.

The Kalabakang river, although larger than the Simmenggaris and Serudang or any of their confluents, has, nevertheless, a comparatively narrow basin, large tributaries flowing into it not being in evidence. The Serudang has also a narrow basin in its lower parts, but its basin expands in the interior, as also is the case, on a smaller scale, with that of the Silompopon.

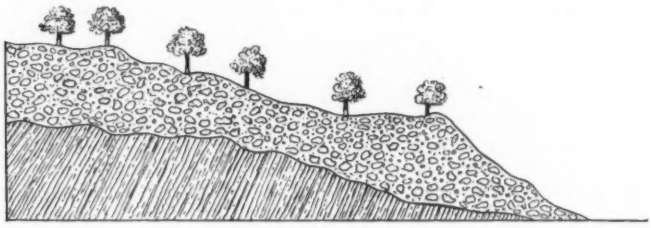
At a distance of about 14 miles up the river from the delta is situated the Tidung village, known by the same name as the river—Kalabakang—up to which the river is one of deposition, flowing down in a meandering course.

Beyond the village, outcrops in the river-bed become numerous. The formation from here onwards consists of thick beds of shales and marls with well-defined bedding, which are sharply folded and traversed by numerous small faults. The formation in this district becomes much more disturbed than it is to the south, and the range which occupies the watershed with the Silompopon appears to mark the boundary of the more disturbed area, which extends northwards. Further up, a loose breccia (Fig. 3), in places, overlies these beds uncomformably, being terraces marking a former level of the river, and thus showing the extensive erosion that has been enacted by the river in the upper parts.

About 7 miles beyond the village the first rapids are reached, which are succeeded by others, above which the river becomes more sluggish and deeper, being readily navigable, wandering in meanders far into the interior and trending approximately west-north-west. In its higher reaches, however, a more northerly course is assumed, and its sources descend in a more turbulent form from the high lands which also contain the sources of the Kwamut river—a large tributary of the Kinnabatangan. There are native reports which state that the Serudang, Kalabakang, and Kwamut all rise in the same hill.

On the north of Cowie harbour a very different formation occurs, consisting of volcanic rocks which rise in hills and mountains, several of which still assume conical forms, thus denoting that volcanic activity took place at a former era in this region, which, though of Tertiary times, occurred subsequently to the period of the Tertiary formation occupying the regions just described. Along the north shore of Cowie harbour, several small rivers and streams pass out which receive the drainage of part of this volcanic hill district. The amount of water passing down these streams is very small. They have, however, extensive tidal portions, but at low tide many of them are almost dry.

At a few miles north-north-west of Tawao is situated a conspicuous and peculiar peak of conical form. It is 608 feet (aneroid) in altitude; it is marked on the chart, however, as being 720 feet. Its rocks form a promontory in the sea called Tanjong Batu (Tanjong—Malay = promontory,



Terrace of Breccia on the bank in the upper reaches of the Kalabakang River

FIG. 3.

Batu—Malay = rock), and the same name is given to the hill, although it is named on the maps "Kukusan." This hill exhibits a remarkable conformation. It is composed of volcanic rocks of an andesitic class, masses and huge blocks of which are piled on each other over the whole of the peak and on all sides, giving rise to deep holes and huge caverns in between the blocks. It is, indeed, possible that the hill may be wholly composed of blocks piled up in this manner. The rocks are marked with curious parallel indents, and, in some places, semispherical cavities, and they have a marked sonorous ring when struck. Notwithstanding the nature of the ground, it is covered with quite a dense jungle, the trees taking root amongst and on the top of these blocks, wherever they can obtain a scanty soil. On account of these huge rocks, the hill is almost impregnable, and were it not for the numerous creepers descending from the trees which give assistance in climbing the cliffs, some parts would be impossible to scale; furthermore, belts of dense thorn bush add to the difficulty of ascent. On the east side of Tawao there is another hill, Batu Tenagat, abutting into the sea, which has a similar arrangement of huge blocks.

Draining the eastern part of this district of volcanic hills, a river, called the Apas, outflows into the sea not far east of Batu Tenagat. This river is remarkable for the presence, in the upper part of its basin, of hot springs depositing calcareous sinter.

It is probable that this region of volcanic rocks extends as far as the vicinity of Darvel bay and the sources of the Segama river, but not much is known concerning this district.

The Segama, by the way, rises some distance to the interior of Darvel bay, and flows in a north-easterly direction, and, passing close to the north-east end of Darvel bay, ultimately flows into the sea on the north of the large promontory of Province Mayne, its delta being continuous with that of the Kinnabatangan.

In connection with this region, it is of interest to notice a reference to it in Posewitz's 'Borneo,'* of which the following is a quotation: "Granite blocks are mentioned as being scattered along the northern shore of Sibuku bay; and not far from the coast, towards the east, is a mountain about 2000 feet high, with gently arching flanks, while in the direction of the river mouth, and in the immediate neighbourhood of the sea, stands a mountain of bold contours and noble proportions, being 3000 to 4000 feet high. Reasoning from analogy, we would expect to find here a rich coral formation, while the granite lying about in blocks points to the presence of the mountain formation." The "granite lying about in blocks" probably refers to the volcanic rocks to which mention has already been made; there are no rocks resembling the granites in the region, while the coral formation is also absent in this locality. The "mountain about 2000 feet high with gently arching flanks" evidently refers to the Tanjong Batu hill, or Kukusan, mentioned above, and 608 feet in altitude. The volcanic rocks of this region are pyroxene andesites, containing enstatite, augite, and accessory horneblende.

With reference to the various river systems described, and the distribution of drainage, it will be noticed that the basins of the majority of the large rivers expand towards the interior. The peripheral areas, however, must be larger than the internal, and it is necessary to account for their drainage. This is principally adjusted by a large number of minor rivers and streams which flow down all along the coast.

It is of interest briefly to consider whether there have been upward or downward secular movements in the district under discussion, and what influence they may have on the formation of deltas which are so remarkably developed in this region. At first sight, it might appear that secular rise would be favourable to the formation of deltas, for the silt and alluvial materials brought down by the rivers and deposited below the sea-level

* 'Borneo: its Geology and Mineral Resources,' Dr. Theodor Posewitz (translated by Dr. F. R. Hatch), p. 159, 1892. And a reference for the above information is given in this work to J. Oesterreicher, B. 31, pp. 210-222.

beyond the margin of the actual deltas would gradually be raised above the sea-level. In this case, however, the waves and currents would probably wash away the materials as fast as they were uplifted, and before there was time for protective vegetation to spring up over them. In the case, however, of secular depression, as the marginal and lower parts of the delta sank beneath the sea, the thick growths of mangrove and nipa would serve to concentrate and catch the silt and sediments brought down by the rivers, while the remains of the submerged vegetation would mingle with the alluvial material to form deposits, upon which fresh vegetation would soon spring up. Moreover, the delta would, at the same time, be carried further backward. In the case of uneven and hilly country, the deltaic deposits would narrow up the valleys, while the more elevated portions would in time become islands—either surrounded by alluvium, or true islands, as the case may be.

Thus it may be concluded that the region under discussion has been, and is, under the influence of secular depression.

The tongues of deltaic formation extending up the valleys, the long tidal limits, and the small streams, nearly dry at low tide, mentioned above as flowing in extensive valleys from the volcanic hill region into the sea on the north coast of Cowie harbour and which could not have eroded their comparatively deep and wide channels at their present level (for a considerable extent below high-water mark), all seem to point to secular depression. Furthermore, in the vicinity of Tawao, the sea is gradually encroaching on cocoanut plantations.

Secular depression may also account for the large islands of Nonuekan and Sebattek which consist of the Tertiary hill formation similar to that of the mainland, and may be regarded as more elevated portions of the former land surface, the intervening depressed areas having become tracts of deltaic alluvium, part of which has become submerged forming the shallow straits which separate these islands from the mainland. Sebattek island is probably a continuation of the range situated to the south of the Kalabakang river and running parallel with its general direction.

Tenelik Island (in the Mouth of the Sibuku).—Tenelek island (Fig. 2) consists of two hills joined by a tract of alluvium, and the recent elevation to which reference has been made as "New hill" is the seaward one of these two hills and overlooks the estuary of the Simmenggaris river. The hill is covered with ferns, which, becoming very dry, periodically ignite, and this circumstance has probably given rise to a native story that phosphorus exists on this hill; nearly the whole of the south side was burnt clear when the writer visited this hill.

The strata dip uniformly towards the west at angles varying up to 45°. They are broken up into more or less rectangular blocks by wide gaping joints. Recent shells occur in pockets in the soil filling these joints on the summit. These shells, now at an altitude of over 100 feet, are similar to the marine organisms which are at the present day denizens

of the sea, being modern Pacific mollusca-genera Murex (*capucinus*), Nerita (*luxata*), and Ostrea. Holes of boring shells, Lithodomis, etc., were found in some of the sandstone beds on the summit.

There are two points north and south of the hill, the north point being the higher, upon which pieces of white hornstone and soft sandstones were strewn, together with numerous small nodules of hard ironstone. Shells could not be found on the north point. On the east side of the hill the succession of strata are exposed in section, dipping generally about 45° W., and giving the appearance of the rock having been tilted away from the face of the hill and truncated, as well as having been broken up into blocks divided by fissures. The hill presents the aspect of a dip and escarpment ridge, but denudation is, of course, not feasible (to account for this appearance), considering its recent age as indicated by the marine remains on the summit.

Although there was not opportunity for examining Plandok island, which lies a short distance towards the north-west, this island appears to be composed of the same rocks, and to be of a similar formation, and may, possibly, also be of recent upheaval.

It is difficult to conjecture what class of diastrophism has caused the formation of this hill. If it has been originated by a fault, either being the upthrown side or caused by the snapping along an anticlinal axis the northern portion of which has been thrown down, a longer extension of the elevated ridge would be expected, although Plandok island might be a small continuation. That considerable pressure has been connected with this upheaval is shown by the extensive fracturing of the rocks.

Although, perhaps, somewhat irrelevant to the title of this paper, reference may be made, while on the subject of recent upheavals, to a new island which made its appearance on September 21, 1897, on the north-west coast of Borneo, opposite Labuan, in lat. 5° 20′ 30″, long. 115° 21′. This upheaval, however, has a very different origin to the elevation described above, having been blown up by natural gas, possibly in combination with seismic activity. The district is notable for mud volcanoes and issues of natural gas in association with traces of petroleum occurring in a disturbed formation. This island has been described by Professor C. Schmidt, who, writing in 1904,* and commenting on the rapidity with which the marine erosion was denuding the soft materials, surmised that at the present day probably nothing would remain of this island. This island was visited, however, by the writer in 1908 and 1909, and although the greater part has been washed away, a considerable portion now remains, measuring 210 feet long, 120 feet wide. It is now, however, no longer an island, having become joined to the shore, from which it was never very far, by drifts of sand. It is called Bukit Tumbo (Malay—Bukit = hill; Tumbo = sprout, rise, or shoot up).

* "Ueber die Geologie von Nordwest-Borneo und eine daselbst entstandene 'Neue-Insel,'" *Beitr. Geophys., Leipzig*, 7, pp. 121–136, pl. VI. (geol. map), 1904, And A. C.

This upheaval was described, in a report, by Mr. Allard, who was in charge of some drilling operations for petroleum in the neighbourhood at the time, as follows :—

" Halfway between Mempakal and Lambedan, on the 21st of September. in the afternoon, a small island was formed. Some natives were out gathering oysters, and noticed a good many bubbles rising, after which a gradual upheaval took place, and went on all night, forming a hill of about 200 yards by 150 yards, and 50 to 60 feet high. It seems to consist of nothing but slatey-looking clay, with a few sandstones in it, exactly similar to what we have been boring through. It is about 30 yards from the shore, and has evidently been forced up through rocks, as some large portions show where it has been scored and marked by passing out between some hard substance. There was a strong smell of gas when I went to see it on the 22nd, and on picking up some of the rocks they showed signs of a white waxy-looking substance having been forced into crevices, so I think this has been forced up by a pressure of gas below. It is not far from where there are some oil signs on the shore."

In this connection, reference may be made to an account, which has been published in the *Journal*,* of a similar occurrence, viz. of an upheaval caused by gas in petroliferous regions, which was observed by the commander of a mail steamer as actually taking place off the Arrakan coast of Burma, in September, 1909. This upheaval appears to have great analogies with that of Bukit Tumbo.

TARAWERA ERUPTION AND AFTER.

By Prof. JAMES PARK, F.G.S.†

Mount Tarawera, the scene of the eruption on June 10, 1886, lies in the White island—Taupo volcanic zone, being situated about 27 miles south of the Bay of Plenty. The summit of the mountain before the eruption presented the appearance of a dissected tableland, the northern portion of which was known as Wahanga, the middle portion as Ruawahia, and the southern as Mount Tarawera. The highest point of the mountain rose to the height of 3600 feet above the sea. On the west, Mount Tarawera sloped down to Lake Tarawera, 1040 feet above the sea ; and on the east and south it rose abruptly from the Rotomahana rhyolitic plateau, 1200 feet above the sea.

Fissure-eruptions, both historical and geological, have been distinguished by the quiet emission of floods of lava. The Tarawera outburst

* *Geographical Journal*, vol. 34, No. 6, December, 1909, p. 690. A. R. W. Handcock.

† The author accompanied Sir James Hector to the scene of the eruption a few days after the outburst on June 10, 1886; and afterwards visited Tarawera in June, 1900; June, 1909; and March, 1910.

FISSURE NEAR TIKITAPU BUSH, AFTER ERUPTION, JUNE 10, 1886. [*Burton, photo.*

[*Burton, photo.*

INTERIOR OF CRATER, TARAWERA, AFTER ERUPTION, JUNE 10, 1886.

was a fissure-eruption in which the ejected material was entirely fragmentary. It would thus appear to represent a rare or altogether new type of vulcanism.

It has been clearly established, on the evidence of European and native eye-witnesses, that the fissure was not formed by a single paroxysmal outburst, but was the result of a comparatively slow rending which began at Wahanga at the north end of the mountain, and gradually travelled southward, passing successively through Ruawahia and Tarawera, thence traversing the plateau until it reached Lake Rotomahana, which lay in its path; whence it passed onwards to Lake Okaro. The time occupied in opening the fissure was three or four hours.

The fissure was nearly 9 miles long. It extended for 4 miles along the summit of Mount Tarawera, and for 5 miles across the Rotomahana rhyolitic plateau, the rent on the low ground running in the same line as the mountain fissure, the general bearing of which was about 58° (true). The greatest width of the fissure was a mile and a quarter, and the mean width 200 yards. The depth varied from 900 feet at the north to 300 feet at the south. Immediately after the opening of the fissure volcanic activity was localized at Wahanga, Ruawahia, Tarawera, Rotomahana, Black crater, and Echo crater. The fissure did not everywhere reach the surface, the centres of eruption being, in some cases, separated by bridges of Tertiary rhyolite.

Mount Tarawera was an old volcano composed of rhyolite flows and tuffs. The country around Lake Rotomahana, for many miles in all directions, was a dissected rhyolitic plateau, on the denuded surface of which lay alternating layers of fine and coarse rhyolitic and pumiceous tuffs, the eject of former eruptions that everywhere conformed to the undulations of the surface on which it was spread. Until the eruption of 1886, no basic or semi-basic igneous lava or tuff was known to exist nearer than Mount Edgecombe, situated 16 miles from Tarawera, and outside the zone of activity.

The eruption, as we have seen, began with the fissuring of Wahanga and the welling up of a semi-basic lava which subsequent examination showed to be augite-andesite. Then followed Ruawahia and Tarawera, from which augite-andesite in the fragmentary form of dust, scoriæ, lapilli, bombs both large and small, and huge angular masses both solid and vesicular were ejected. When the rending fissure reached Lake Rotomahana, it came in contact with a considerable body of water. The result was a shattering explosion that converted the old lake-bed into an active volcano a mile and a quarter wide. The material projected from Rotomahana and the craters along the plateau fissure was mainly rhyolitic. But the rhyolitic ash was mingled with a considerable proportion of andesitic dust and scoriæ, even as far south as Lake Okaro; and an examination of the larger blocks projected from the plateau craters shows the presence of many large masses of andesite that could not very well

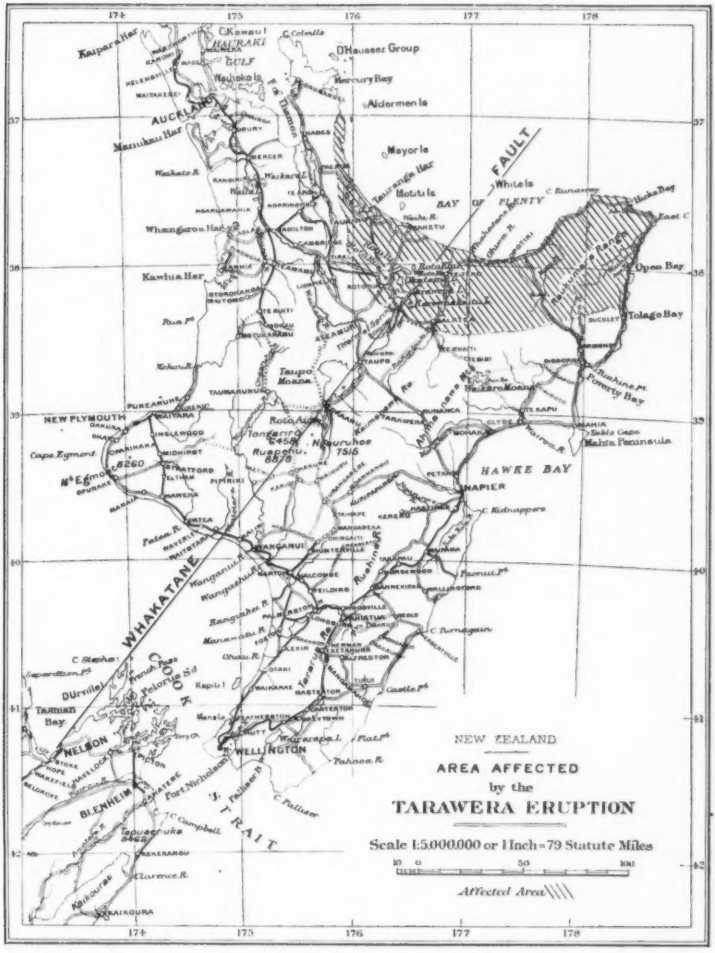
have been derived from Mount Tarawera. As a matter of fact, for some days after the eruption, the author, during his visits to Te Hape-o-Toroa, found that the only solid material being ejected at Rotomahana and Black crater consisted of boulders of black andesite.

That andesite lava welled up in the fissure in the Rotomahana area, as well as in the overhanging rent in Tarawera, seems to be a conclusion in every way in harmony with the facts. It would, however, appear that the lava did not rise so high as at Tarawera, a circumstance that may have been due to the cooling effect of the lake waters. On the other hand, the water becoming suddenly converted into steam by contact with the molten matter below would inevitably exert an enormous explosive force, which, following the line of least resistance in an upward direction, would shatter the overlying rhyolites and sinters into the dust and fragments which we now find covering the Rotomahana end of the field of volcanic activity.

Radiating northward from Tarawera and thence spreading out to the north-east and north-west like an open fan, the covering of dust, sand, and scoriæ is wholly andesitic. The scoriæ is coarsest between the radii passing through Lake Rotoiti and Tarawera river, being especially coarse in the belt between Mount Tarawera and the sea in the line of prolongation of the fissure. Beyond these radii, the eject material passes into a coarse sand, which, north-west of Te Puke and north-east of Opotiki, graduates into a fine dust.

The volcanic ejecta were spread over an area of nearly 6000 square miles in a sheet varying from 0 to 50 feet thick, the greatest thickness being found in the immediate vicinity of the fissure. It did not extend far beyond the scene of activity on the eastern side of the rent, owing to the strong southerly wind which was blowing at the time of the eruption. On the other hand, this wind, while limiting the effect of the eruption on the east side, helped to carry the ash westward a distance of 10 or 12 miles towards Rotorua, and northward to the sea between Tauranga and Opotiki, a distance of 75 miles. At the same time, a thin coating of excessively fine wind-borne dust was deposited as far north-west as Tairua, and as far north-east as East Cape. Dust also fell on vessels in the Bay of Plenty, 150 miles from Rotomahana, but it was only within a radius of 12 miles of Tarawera that the material was thick enough to have a destructive effect. At the south end of the fissure, the ejecta extended about a mile to the westward, but north of this it spread over a gradually widening area until opposite Tarawera it reached as far as Tikitapu, 12 miles from the rent in Mount Tarawera. Wherever the dust or mud was over 2 feet thick the vegetation was entirely destroyed; and even where only 12 inches thick the trees were stripped of their foliage and branches, and so badly injured that the majority of them eventually died. The native village at the Pink Terrace, on the shore of Rotomahana, being situated on the edge of the fissure-rent, was blown out of existence,

and the inhabitants, 11 in number, were instantly killed. The native villages at Te Ariki, Moura, and Te Wairoa were overwhelmed with dust and mud, all the inhabitants of the first two being killed, namely 52



natives at Te Ariki and 39 at Moura. The 14 killed at Te Wairoa included several Europeans.

As a result of the eruption, the hills and valleys adjacent to Rotomahana were covered with a smooth sheet of grey ash, the thickness of which could not then be ascertained. This once smooth mantle has become, in recent

years, scored by the rain into narrow V-shaped ridges and corresponding gutters that furrow the slopes from top to bottom. Outside the furrowed area, which lies close to the seat of volcanic activity, the ash is now covered with a dense jungle of vegetation, consisting mainly of bracken, tutu, veronica, tree-ferns, and many forest trees, among which the introduced blue gum and prickly acacia of Australia are conspicuous. It was some three or four years after the eruption before vegetation began to establish itself, but since the year 1890 the growth has been rapid, many of the gums at the buried village of Te Wairoa having grown to a height of over 30 feet.

The dissection of the ash-sheet has revealed many points of interest that could not be formerly observed. It is now seen that the greatest proportion of black andesitic ash occurs at the Tarawera end of the fissure, and the least at the south end. It is also found that the explosions which took place during the earlier stages of the paroxysm broke up into large blocks and piled into ridges the older rhyolitic lavas that formed the sides of the fissure-rent. Among these masses of rhyolite there occur innumerable angular blocks of siliceous sinter, and also many semi-rounded boulders of augite-andesite ejected from the vents during the progress of the eruption. The ash-sheet, as seen from the floor of the fissure which is now quite accessible between Echo and Rotomahana craters, is found to consist of alternating thin layers of fine grey dust, of grey dust mingled with black andesitic ash, and of andesitic ash or fine andesite rubble, the whole being partially consolidated. The material everywhere presents a well-stratified appearance; and if the conditions under which it was deposited were not so well known it might be easily mistaken for a sub-aqueous tuff. The alternation of fine and coarse ash is due to the varying fineness of the material ejected by the different explosive outbursts which followed each other in rapid succession; and in some degree to the wind with its powerful intermittent gusts, which effected a sorting or winnowing action by removing the finer dust to a greater or less distance from the craters. It is noticeable that the inclination of the ash-beds is always towards, and not away from, the centres of eruption. In all cases the layers of ash lie parallel to the original surface of the ground on which they rest; and they maintain a uniform thickness for considerable distances. The premonitory signs of the coming disaster consisted of subterranean rumblings and earth-tremors lasting several hours; but whether these were of such a nature as to cause anxiety or alarm to those living near Rotomahana and Tarawera is unknown, since all the native villages within a radius of 4 miles were destroyed, not a soul escaping. It is, however, certain, from the evidence of the survivors at Te Wairoa, situated on the west side of Lake Tarawera, that the titanic outburst which split Mount Tarawera in twain from end to end and opened the yawning fissure that stretched southward for miles over the low plateau near Rotomahana, took place with appalling suddenness. For a space of four hours the craters

SITE OF THE DESTROYED VILLAGE OF MOURA, TARAWERA. [*Burton, photo.*

[*Shepherd, photo.*

ROTOMAHANA MUD HILLS.

situated on the line of the newly-formed rent poured out piles of ash that overwhelmed the whole country, which, as far as the eye could reach, was converted into a weird grey-draped smoking desert. After this the violence abated; and at the time of the author's visits to Mount Te Hape-o-Toroa, situated on the edge of the fissure overlooking Lake Rotomahana and commanding a perfect view of the whole field of volcanic activity, the vents on Mount Tarawera, at Rotomahana, Black crater, and Echo crater were centres of great activity from which clouds of andesite boulders were projected high into the air, some being shot over the crater-rim, where they were piled up in confused masses, others, and apparently the majority, falling back into the throats of the vents, where they were churned up by the escaping steam until again tossed out. The steam issued from the vents with a terrific continuous roar, and the descending blocks of rock struck the ascending with shattering violence, the united effect being stupefying and overpowering. At short intervals, that rarely exceeded twelve minutes, there took place heavy underground bumps, such as might be caused by subterranean explosions. These were instantly followed by short, sharp earthquakes of such violence that it was, after a time, deemed advisable to withdraw to the vicinity of Black crater, as there seemed to be an imminent danger of the hill being precipitated into Rotomahana crater.

The chief centre of activity at this stage was the Rotomahana vent, from which there issued a vast pillar of steam that reached to a height of over 15,000 feet. After a few months of violent hydrothermal activity, solfataric action gradually waned and in time practically ceased, thus permitting the crater to become filled up with water, forming a new Rotomahana which is many times the size of the old lake. Things remained in this state for a number of years, until about 1897, when geysers again began to play.

In 1900 there came into existence Waimangu geyser, situated in the floor of the fissure-rent at the north end of Echo crater. This world-famed geyser played intermittently up till 1908, at times projecting an enormous column of water and mud to a height of over 1200 feet. Although Waimangu has ceased to play, solfataric action is still very conspicuous in the floor and on the walls of the old rent at Echo crater, and on the western shores of Rotomahana, the waters of which are warm and heavily mineralized, possessing a yellowish-green colour.

Large masses of yellow iron pyrites (FeS_2) are abundant in the sinters and pumiceous rhyolites at Rotorua. Their origin has always been somewhat obscure, but is no longer so, as iron sulphide can be clearly seen in the process of formation at Echo crater. The floor of this crater, as seen by the author in March, 1910, was covered with a thin siliceous crust, through which boiling water and steam escaped in all directions. Through the interaction of the hot, ascending mineralized waters and the sulphuretted hydrogen with which the steam is charged, iron sulphide was being

deposited, at first as a black and then a bright yellow film, on all the loose stones lying in the bubbling, seething portion of the crater known as the "Frying Pan."

Since the date of the emission of the flow of rhyolite which forms the ring of hills surrounding Rotorua and Rotomahana craters, as well as the plateau that extends northwards to Katikati, Tauranga, Te Puke, Maketu, and Whakatane, westward from Thames valley to Middle Waikato, and southward to Taupo, forming also the plateau that stretches into the headwaters of the Waipa, Mokau, and upper Wanganui, there have been two eruptions in the Rotomahana-Rotorua area, the chief product of which was showers of pumice and rhyolitic ash. These outbursts were in many respects similar to the memorable eruption of June, 1886. They took place after the dissection of the rhyolite plateau, as proved by the circumstance that the ash-beds follow the contours of the spurs and ridges that have been carved in the plateau.

The old buried land surfaces with their black loam and charred timber can be clearly seen in many places. Just how long these eruptions preceded that of 1886 is unknown. It is, however, obvious that the intervals of rest between them were of sufficient duration to permit the ash-covered land to become clothed with dense vegetation before the next eruption took place. The ejecta of these old eruptions consist of fine and coarse rhyolitic tuffs and pumice that are spread over the ground in thick and thin layers. The andesitic ash so conspicuous in the Tarawera ejectamenta is entirely absent in the material emitted by these prehistoric outbursts.

The origin or cause of the Tarawera eruption in 1886, like that of most volcanic eruptions, is still a matter for speculation. The welling up of a molten magma with resultant fissuring and sudden admission of the waters of Lake Rotomahana to the uprising glowing mass, and the collapse of the dome that supported the floor of the lake, accompanied by the instant contact of the waters with a highly heated igneous mass lying immediately under the line of fracture, is the hypothesis that has received the most attention and support.

Rotomahana and Tarawera lie on the line of the great Whakatane Fault, a dislocation which extends from the Bay of Plenty to Ruapehu, and on which are situated the only active and intermittent volcanoes in New Zealand. Along this great tectonic fracture are situated White Island volcano, Tongairiro, Ngauruhoe, and Ruapehu, which are either active or intermittent; also Mounts Edgecombe, Kakaramea, and Tauhara, all dormant or recently extinct. It is along this fault that we find the great display of hydrothermal activity that has made Rotorua, Wairakei, and Taupo celebrated as tourist resorts. Elsewhere there is no solfataric action in the Dominion except the expiring effort at Ohaeawai, in the Bay of Islands district. Moreover, it is along this volcanic zone that is situated the North Island chain of wonderful crater-lakes, among which we have,

beginning at the north, Rotoma, Rotoehu, Rotoiti, Rotorua, Okataina, Tarawera, Rotomahana, Okaro, Rotokawa, and Taupo. These crater-basins were, it would seem, the scene of rhyolitic eruptions in the late Pliocene. At any rate, the presence of pumiceous tuffs and pumice sands interbedded with the marine newer Pliocene strata of the Wanganui, Hawke's bay, East cape, Opotiki, and Whakatane districts prove that widespread acidic eruptions took place along this fracture-zone some time about that epoch. The earlier rhyolites form the floor on which the andesitic mountains Ruapehu, Ngauruhoe, Tongairiro, Tauhara, and Edgecombe were afterwards piled.

Volcanic eruptions, at first acidic and afterwards semi-basic, have been in progress along the Whakatane fault-zone from the Pliocene up to the present day. The eruption of 1886 was therefore not an unusual or altogether unexpected occurrence, although it may be not easy to assign the immediate cause. It is now becoming generally recognized by geologists that many earthquakes, perhaps the majority, if not all of them, are caused by the jolts resulting from the settlement of crustal segments along great lines of tectonic fracture. Volcanic activity is not infrequent along these zones. In such cases, it may be that the fracture is of sufficient magnitude as to afford, at different points in its course, communication with the molten magmas below.

There seems to be good reason for the belief that the immediate cause of the eruption was the uprising of a molten mass charged with water and gases. No lava overflowed the fissure, because the excluded steam and gases caused its disruption and dispersal as dust, scoriæ, bombs, and angular blocks.

DAVID THOMPSON, A GREAT GEOGRAPHER.

By J. B. TYRRELL, Toronto, Canada.

It gives me a great deal of pleasure to have the opportunity of submitting to this distinguished assembly a few of the facts on which I venture to claim that David Thompson, of whose achievements but little note has been taken, was the greatest land geographer that the British race has produced.

A poor boy from a London charity school, he spent most of his life on the northern part of this continent when it was a wilderness, peopled only by the natives and by a few fur traders, who had little groups of houses or factories, often hundreds of miles apart, scattered along the principal waterways.

He was a fur trader in the employ of the Hudson's Bay and North-West Companies, and in the prosecution of this trade he travelled many thousands of miles in canoes, on horseback, and on foot through what was then a vast unmapped country, extending from Montreal on

the east to the Pacific ocean on the west, and from Athabasca lake on the north to the headwaters of the Mississippi river on the south. Wherever he went he made surveys, and wherever he stopped he took astronomical observations for latitude and longitude. When he left the western country in 1812, he had the material for a great map, which he drew in the following year, and which has been the basis for every map of northern and western Canada published since that time. After retiring from the fur trade, he was engaged on the part of Great Britain in surveying the boundary-line between the United States and Canada, subsequent to which he settled down quietly in Montreal.

David Thompson was born in London, England, on July 30, 1770, his parents' names being David and Ann. His daughters used to say that their grandparents were Welsh or of Welsh extraction, and that their names had originally been ApThomas, but on this point there is no further evidence. When seven years old he was placed in the Grey Coat School, which is still standing, though now used exclusively for girls, about a quarter of a mile west of Westminster Abbey, and not far from the Canadian Government Office on Victoria Street. Here he remained for seven years, absorbing the ordinary subjects that were taught to a boy in those times, and, in addition to the subjects taught to most of the children, he and one other boy received lessons in navigation. He says that in his leisure hours he used to pore over 'The Tales of the Genii,' 'The Persian and Arabian Tales,' 'Robinson Crusoe,' and 'Gulliver's Travels.'

About the end of the year 1783, the Hudson Bay Company applied "to know if this Charity could furnish them with four boys against the month of May next, for their settlements in America." David Thompson was the only boy available, and in the following May, when just fourteen years old, he was bound as an apprentice to the Hudson Bay Company for seven years, and was sent out to Fort Churchill, on Hudson bay, in the ship *Prince Rupert*. Samuel Hearne, the discoverer and explorer of the Coppermine river, was then governor of Fort Churchill, and though there seems to have been little sympathy between the older explorer and the younger one, in spite of the fact that they were both natives of London, he was, at his own solicitation, employed in copying a few leaves of Hearne's journal, and he must have added to his love of exploration from what he there read, and from the stories of the trip which he heard from those around him. But no attempt was made to employ him in any surveying work, or to make use of the little knowledge of navigation which had been taught to him in school.

From Fort Churchill he was sent down the bleak, open shore of Hudson bay on foot to York Factory, a distance of 160 miles. Here he remained for two years, employed as a clerk in the fur-trading store and in hunting the birds and other game of the country to help to

provide food for himself and those living at the fort with him. All ideas of making surveys had been forgotten—in fact, it is not likely that any serious intention was ever entertained of employing him as a surveyor in the interior countries. His knowledge of navigation was doubtless merely to enable him to sail one or other of the little sloops which were kept by the Hudson Bay Company at their trading-posts on the shore of the bay.

In the year 1787, when seventeen years old, he was, however, sent inland with a party which was going to establish new trading-posts on the Saskatchewan river, and for the next three years he lived on the banks of that stream and on the adjoining plains to the south of it, learning the habits of the Indians, and inducing them to bring their furs to the stores to exchange for the commodities brought from England by the white people. One whole winter was spent in the tent of a chief of the Peagan Indians, one of the wildest native tribes of the West, and the friendships there formed stood him in good stead in his after-life.

In 1789, when at Cumberland House on the Saskatchewan, he began to use a notebook, and to take and record regular meteorological observations. The following year, while on a journey to York Factory with the brigade of furs, he made his first survey in the country. His notebooks show the courses and distances of all the reaches on the Saskatchewan and Hayes rivers, as well as the north shore of Lake Winnipeg.

After his return to Cumberland House in this year, he had the advantage of the society of one Philip Turner, a surveyor who had been sent out by the Hudson Bay Company to make a survey of Lake Athabasca, and under him he devoted himself heartily to the study of practical astronomy. During that winter he took many observations for the latitude and longitude of Cumberland House, and the position which he determined for it is the same which it now occupies in the latest maps published by the Canadian Government, although the position has varied greatly in the maps which have been published in the intervening one hundred and twenty years.

In 1791 he returned to York Factory, where he remained for more than a year, assisting in the fur trade and filling in all his spare time with taking astronomical observations. In 1792 he again left York Factory, but this time he went into what he calls the "Muskrat Country," which lies west of Nelson river, between Saskatchewan and Churchill rivers, where he spent the following winter. In 1793 he returned to the Saskatchewan, spending the winter at a place called Buckingham House, about halfway between Battleford and Edmonton; and the following summer he made a survey of the river down to Cumberland House, thus adding a considerable stretch to the part of the river he had already surveyed below that point.

The next three years were spent in the Muskrat country, making surveys of all the lakes and streams that he passed through in his

search for furs. These surveys extended northward as far as Reindeer lake and westward to the east end of Lake Athabasca, where he connected with the survey previously made by his tutor, Mr. Turner.

The year in which he made this latter survey would seem to have been a poŏr one for fur returns, and his superior officer in the company probably thought he had neglected the fur trade in the interest of exploration, so he gave orders that the surveying must be discontinued. This Thompson refused to agree to, and as his second term of engagement was expiring, he withdrew from the service of the Hudson Bay Company and entered that of the North-West Company, which was particularly anxious at the time to have the position of its trading-posts determined. This was on May 23, 1797, the following entry being written in his journal of this date: "This day left the service of the Hudson Bay Company, and entered that of the Company of the Merchants from Canada. May God Almighty prosper me." Thus for the sake of a trifling shortage in the fur returns for the year, the Hudson Bay Company lost the greatest man it ever had in its employ, a man whose name will be a household word with educated men and women in America long after all the fur traders and their beaver-skins have been forgotten. On May 28 he arrived on foot at the house of Mr. Alex. Fraser, at the head of Reindeer river, where he was very hospitably entertained by this partner in the North-West Company. He at once proceeded from Reindeer lake to Grand Portage on Lake Superior, making as usual a survey of the route which he followed. Here he received his instructions, and made final arrangements for his future work. The explorations of the next year are worth following in some detail, as they show what such a man could do under reasonably favourable circumstances.

On August 9 he left the "Grand Portage," at the mouth of Pigeon river on Lake Superior, in company with Mr. Hugh McGillis, and descended Rainy river, passing a fort at the Falls on the 21st, went on through Rainy lake and Lake of the Woods to Lake Winnipeg, which he reached on September 1. Crossing this lake and ascending the Dauphin river, he reached Lake Manito (Manitoba) on September 10. He crossed this lake, and reached Lake Winnipegoosis by way of the Meadow portage. On September 17, being camped 1½ mile north of the Little Dauphin (Mossy) river, provisions were received from Fort Dauphin, on or near Dauphin lake.

On September 17, having received provisions from Fort Dauphin, the party proceeded northward up the west shore of Lake Winnipegoosis. On the 19th, Mr. Hugh McGillis left him to go up Red Deer river, while he himself reached the mouth of Shoal river. He ascended this river, passed through Swan lake, and ascended Swan river for 4¾ miles to Swan River house, on the north bank of the river, which would place it near the north line of Tp. 39 in lat. 52° 24′ 5″ N. The Hudson's

Bay Company also had a post in the immediate vicinity. Horses were then in common use on the Swan River valley, for after stopping a day at this post, he and Mr. Grant started on horseback up the valley on a trail which ran for most of the distance along the north side of the river. On the second day they crossed the Swan river to the south side, and rode 6 miles to a house kept by one Belleau in a "hammock of Pines" on the bank of Snake creek, almost on the Second Initial Meridian, about 6 miles north of Fort Pelly. From here he turned southward, and continued his survey past the post of the Hudson's Bay Company at the Elbow of the Assiniboine river to the house of Cuthbert Grant, which was situated in Tp. 28, Range 31, and south-west of the present village of Runnymede, on the Canadian Northern railway.

Here he remained till October 14, when he returned to Belleau's house on Snake creek, in order, if possible, to obtain guides to take him up the Swan river, across the watershed to Red Deer river, and thence around to the headwaters of the Assiniboine river. From this date to November 28 his journal was lost, but he states, "I surveyed the Stone Indian (Assiniboine) river upward and its sources, and the Red Deer river and its sources, and from thence returned to the house of Mr. Cuthbert Grant, at the Brooks, on the Stone Indian river."

He, however, gives traverses worked out by latitude and departure which show his course to have been from Belleau's house to the upper house on Red Deer river in lat. 52° 47′ 44″ N. From here he turned south-westward, and continued his survey to the "upper house on the Stone Indian river," afterwards known as Alexandria, where Daniel Harmon spent five years of his life in the west, from 1800 to 1805, and which is said by him to have been "built on a small rise of ground on the bank of the Assiniboine, that separated it from a beautiful prairie about 2 miles long and from 1 to 4 broad, which is as level as the floor of a house." At a little distance behind the post are small groves of birch, poplar, aspin, and pine. From Alexandria he travelled down the river to the Elbow, and thence to Cuthbert Grant's house. Thence he continued southward to Thorburn's house on the Qu'apple river, a few miles above its mouth, in lat. 50° 28′ 57″, and McDonald's house, $1\frac{1}{2}$ mile above the mouth of the Souris river.

The winter had now set in, when travelling on the open plains was unpleasant and dangerous, but Thompson was anxious to find out the exact positions of those Indian villages on the Missouri, where the people lived by the cultivation of corn as well as by hunting buffalo, and personal inconvenience and danger were not to be considered when compared with the satisfaction of this craving for knowledge. Besides this, some of the Indians might be induced to establish a regular trade with the North-West Company. So on November 28, 1797, he left McDonald's (Assiniboine) house with nine men, a few horses, and thirty dogs, and started south-westward across the plain. On December 7 he

reached Old Ash House on the Souris river, "settled two years ago, and abandoned the following spring."

Having been unable to procure a guide here, he himself assumed the head, and, going by Turtle mountain, again reached the Souris or Mouse river, which he followed up to the "bight," whence he crossed the plains, a distance of 37 miles, to the Missouri river, reaching it on December 29 at a point 6 miles above the upper of the Mandan villages. These villages are stated to have been five in number, and contained in all 318 houses and seven tents, inhabited by Mandan and Willow Indians in about equal numbers. The number of the Willow Indians in another place in his notes (there called Fall Indians) is placed at 2200 to 2500. He remained at these villages till January 10, trying to induce the Indians to come north to trade, but with very little success, as they were afraid of the Sioux. While here he wrote down a vocabulary of the Mandan language, containing about 375 words.

On January 10, 1798, he left the villages, but being delayed by severe storms, it was the 24th before he reached the Souris river, and February 3 when he arrived at McDonald's house at the mouth of the Souris river. At Souris river post he remained till February 25, 1798, not to rest and enjoy himself after the hardships of his journey, but to make up his notes and plans and prepare for a longer trip, this time on foot, to connect the waters of the Red and Mississippi rivers, and thence onward to Lake Superior, a trip which his companion ridiculed as being impossible to accomplish before the advent of summer. On the above date he started out on foot with a dog-team, and followed the course of the Assiniboine eastward to its mouth, making, as he always did, a survey of his route, passing on his way Pine fort and Poplar house, both of which had been abandoned, and some houses a little below the Meadow Portage to Lake Manito Bah.

On March 7 he reached the forks of the Assiniboine and Red rivers at the present city of Winnipeg, though no mention is made of any habitation there at the time. Travelling on the ice, he turned up the latter stream, and on the second day reached Cheboillez's old house of the North-West Company, a quarter of a mile up Rat creek above its mouth, the latitude of which was 49° 33′ 58″ N., which would be a few miles west of Niverville on the Emerson branch of the C.P.R.

On March 14 he crossed the boundary-line into the United States, and reached the house of Mr. Charles Cheboillez at the mouth of Summerberry or Pembina river in lat. 48° 58′ 29″ N., at the present town of Pembina in North Dakota. After staying here for a week he continued up Red river, passing the house of the North-West Company kept by Mr. Roi, at the mouth of Salt river, also in North Dakota, to the mouth of Red Lake river, which he ascended to the mouth of Clear river, where there was a North-West Company's house kept by Baptiste Cadotte, which he places in lat. 47° 54′ 21″ N., close to the present site

of Red Lake falls. He reached this house on March 24, and at once endeavoured to proceed eastward on foot, but was obliged to return and wait for the breaking up of the ice, as "the snow thawing made the open country like a lake of open water."

On April 9 he again started from Cadotte's house, but this time in a canoe with three men, and ascended Clear river for six days, when he carried across to Red Lake river, which he ascended to Red lake, reaching it at a point in lat. 47° 58′ 15″ N. Two miles to the south was an old house once occupied by Mr. Cadotte. After traversing the south shore of Red lake for a considerable distance eastward, he turned southward, and at a point in lat. 47° 53′ 42″ N. crossed a carrying-place 6 miles long, after which he wound his way through small lakes and brooks, and walked over short portages till, on April 27, he arrived at Turtle lake, from which flows "Turtle brook," which he states to be the source of the Mississippi, since it is from here that the river takes the most direct course to the sea. Thus, to this indefatigable but hitherto almost unknown geographer belongs the honour of discovering the head waters of this great river, about whose source there has been almost as much discussion as about that of the Nile itself. His course is well laid down on his great "Map of the North-West Territory of the Province of Canada, made for the North-West Company in 1813–1814," drawn on a scale of about 15 miles to an inch, and now in the possession of the Government of the Province of Ontario.

An excellent account of the early expeditions to the headwaters of the Mississippi is given by Mr. N. H. Winchell, in his Historical Introduction in the Final Report on the "Geology of Minnesota," 1884. In speaking of Lieut. Pike's journey to Red Cedar (Cass) lake in 1806, he there states that, "Mr. Thompson's maps and papers never having been published, Lieut. Pike is to be accredited with the first authenticated examination of the Mississippi valley from the St. Francis river to Red Cedar lake." The first man who is stated to have travelled through the country north of Red Cedar lake was J. C. Beltrami, an Italian gentleman, who accompanied Major Long's expedition as far as Pembina. He ascended Bloody (Red) lake river, and thence followed Thompson's route to Turtle lake, whence he descended the Mississippi to its mouth. This was in the summer of 1823, nine years after Thompson had recorded his discoveries on the above-mentioned map, and twenty-five years after he had made the survey of his course.

From Turtle lake, Thompson descended Turtle brook to Red Cedar (Cass) lake, on which there was a North-West Company's house, kept by Mr. John Sayer, which he places in lat. 47° 27′ 56″, long. 95° Remaining here from April 29 to May 3, he again embarked, and struck across to the Mississippi river, down which he travelled, through Winnipegoosis lake, to the south of Sand Lake river, where he left the main stream and turned up Sand Lake river to Sand lake, on which was

a house belonging to the North-West Company, south 14°, east 1¼ mile from the head of the river, and in lat. 56° 46′ 39.″ From this house he crossed the lake to the mouth of Savannah brook, which he followed up to the Savannah carrying-place, a deep bog 4 miles across. Crossing this portage to a small creek that flows into St. Louis river, he descended the latter stream to Fond du Lac house, in lat. 46° 44′ 2,″ 2½ miles up the river from Lake Superior. He reached this post on May 10, two months and eighteen days after leaving the mouth of the Souris river. From here he surveyed the south shore of Lake Superior, arriving at the falls of Ste. Marie on May 28.

On June 1 he left Sault Ste. Marie in a light canoe with eleven men in company with Messrs. McKenzie, McLeod, and Stuart, and reached Grand portage on the 7th, where he remained till July 14. The time was a busy one at this the central post of the company, and in his journal he gives a very interesting account of the men who were almost daily arriving from and departing for many widely separated points throughout the west. Since he had left here one year before, he had been on a continuous journey of survey and exploration of unexplored country, and his survey, approximately 4000 miles long, made in that time is a record that has rarely been equalled. From that time, year after year, he continued his survey throughout the northern portions of the North American continent, travelling in canoes, on horseback, or on foot, as occasion offered.

In addition to the surveys enumerated above, he re-surveyed the Saskatchewan river from its mouth to its source, and, east of the Rocky mountains, he also made surveys of the Bow and South Saskatchewan river; Churchill river down to South Indian lake; Athabasca river from its source to its mouth; Peace river from Fort St. John down to its mouth; Clearwater river, Beaver river, and the whole or parts of Lakes Athabasca, Lesser Slave, La Biche, Winnepeg, etc.

In 1807, he crossed the Rocky mountains by the Saskatchewan pass into what is now the province of British Columbia, and ascended the Columbia river to its source, where he built a trading post and spent the winter. From that time onwards until 1812, much of his time was spent in British Columbia and the adjoining states of Washington, Idaho, Montana, and Oregon. During these years he surveyed the Columbia river from its source to its mouth, the Kootenay river, parts of Canoe, Pend d'Oreille, Clark's fork, and Lewis rivers, Flathead lake, and many other smaller rivers and lakes, in all covering many thousands of miles of new and previously unexplored country.

In 1811, when he reached the mouth of the Columbia river, he wrote as follows, "Thus I have fully completed the survey of this part of North America from sea to sea, and by almost innumerable astronomical observations have determined the positions of the mountains, lakes, and rivers, and other remarkable places on the northern part of

this continent. The maps of all these surveys have been drawn, and they are laid down in geographical position. This work has occupied me for twenty-seven years."

These surveys were not merely rough sketches sufficient to give some idea of the general character of the country, but they were careful traverses made by a master in the art, short courses being taken with a magnetic compass, the variation of which was constantly checked; distances carefully estimated by the time taken to travel them, and the whole checked by numerous astronomical observations for latitude and longitude.

It has been my fortune to follow Thompson's courses for thousands of miles through this western country, and to take astronomical observations on the same places where he took them, and it is impossible for me to speak too highly of the general excellence of these surveys and observations. For three-quarters of a century Thompson's map was the standard of North-Western Canada, and even yet some parts of it have not been superseded.

In 1812, after having spent twenty-eight years in the wilderness of Western America, but at the same time being only forty-two years of age, Thompson retired from the service of the North-West Company and settled at Terrebonne, in Lower Canada (Quebec), where for a couple of years he was engaged in completing his great map of the North-West Territory which for years hung in the headquarters of the North-West Company at Fort William, and is now in possession of the Province of Ontario.

In 1816, this boy from a charity school in London, who had educated himself as a surveyor in the forests and on the plains and mountains of the west, was appointed by the Government of Great Britain as its astronomer and surveyor to determine and define the boundary-line between the United States and British North America (Canada) under the Treaty of Ghent. The years from 1816 to 1825 were occupied in performing this great international survey, and the maps which he made are still and will always continue to be the ultimate authority on this long line dividing two nations, extending from the state of Maine to the north-west angle of Lake of the Woods.

His last years were spent either in Glengarry county, Ontario, or in Longueil, opposite Montreal, where he died on February 10, 1857, at the ripe old age of nearly eighty-seven years. His wife, a child of the Western country, whom he married at Isle a la Crosse, on the Churchill river, survived him by less than three months, dying on May 7 of the same year.

Thompson's work must not be confused with that accomplished by ordinary explorers, or even with that of many of the clerks of the fur companies who have written journals and have given us excellent accounts of the new countries through which they travelled. Their

work was descriptive and general, his was detailed and exact, so that wherever he went others could follow him. They described small portions of the country, he learned of the physical features of all the vast country through which he travelled, and grouped these features together on a map in one harmonious whole, so that not only could any individual course or route of his be followed, but the relations of these courses to each other, their distances from each other and from any other place on the surface of the Earth was known for all time to come.

Dr. J. J. Bigsby, the naturalist of the International Boundary Commission, thus speaks of his first meeting with David Thompson in Mr. McGillivary's home in Montreal about the year 1817. "A singular-looking person of about fifty. He was plainly dressed, quiet, and observant. His figure was short and compact, and his black hair was worn long all around, and cut square, as if by one stroke of the shears, just above the eyebrows. His complexion was of the gardener's ruddy brown, while the expression of deeply furrowed features was friendly and intelligent, but his cut, short nose gave him an odd look. His speech betrayed the Welshman.

"No living person possesses a tithe of his information respecting the Hudson's bay countries, which from 1793 to 1820 he was constantly traversing. Never mind his Bunyan-like face and cropped hair; he has a very powerful mind, and a singular faculty of picture-making. He can create a wilderness and people it with warring savages, or climb the Rocky mountains with you in a snowstorm, so clearly and palpably, that only shut your eyes and you hear the crack of the rifle, or feel the snow-flakes on your cheeks as he talks.

"Mr. Thompson was a firm Churchman, while most of our men were Roman Catholics. Many a time have I seen these uneducated Canadians most attentively and thankfully listen, as they sat upon some bank of shingle, to Mr. Thompson, while he read to them in most extraordinary pronounced French, three chapters out of the Old Testament, and as many out of the New, adding such explanations as seemed to him suitable."

He never used alcoholic liquors, and during the time that he was in control of the fur trade west of the Rocky mountains, and while most of the posts kept by the fur traders were merely bar-rooms of the very lowest type, where the Indians were encouraged in drunkenness and debauchery of every kind, no alcoholic liquor was allowed to be brought to any post under his charge. Both morally and scientifically, he was a man of the very highest type. As a discoverer and explorer of new continental lands, he stands in the highest rank.

EXPERIMENTS ON THE SETTLEMENT OF SOLIDS IN WATER.*

By Dr. JOHN S. OWENS.

In the discussion on my paper, entitled "Experiments on the Transporting Power of Sea Currents," before the Research Department in November, 1907, it was suggested by Dr. Vaughan Cornish that experiments on the rate of settlement of sand and shingle through water should be made. The kindness with which the Department received the account of my previous experiments, and the encouragement given to me then, have prompted me in the carrying out of the work about to be described and in the preparation of this paper. The work of preparing for and carrying out the actual experiments has occupied a longer time than was at first anticipated, principally owing to the necessity for devising some way to measure the velocities of bodies which fell too rapidly to be timed by a stop-watch, and also to the necessity for finding out by trial and error the best way to do the experiments, and to keep them free from the sources of error which often only appeared when some time had been spent experimenting.

The paper is primarily a description of experiments, and the utmost care has been taken to reduce error in these. Some of the points brought out are, I think, new, and although I have tried to discover the practical bearing of these on pro blems connected with deposition, I feel sure that by placing the matter before the Research Department further light will be thrown on the obscure points by the wider knowledge and experience of other members.

The following is a list of the experiments conducted:—

(1) The fall of particles of shingle, spheres of stone, metal, and wax through water.

(2) The settlement of sand grains through water.

(3) The effect of suspended matter on the density of water.

(4) The effect of fine suspended matter on the rate of settlement of coarser sand.

(5) On the formation and rate of fall of "surface of separation" in muddy water, and on the effect of the quantity of suspended matter present on its rate of settlement.

(6) Effect of temperature on rate of settlement of suspended matter.

(7) Method of settlement as determined by shape of body.

Experiment 1.

The Fall of Particles of Shingle, Spheres of Stone, Metal, and Wax through Water.

In this section I have grouped together all the experiments dealing with the rate of fall of large particles—that is, of such as fall between about $\frac{1}{8}$ inch and $\frac{1}{2}$ inch diameter. In certain cases where the rate was low, it was possible to measure the rate of fall by simply allowing the bodies to fall through a glass tube filled with water, and timing the interval between two marks on the tube with a stop-watch. This method was only applicable with the smallest and lightest bodies. With an ordinary pebble half an inch in diameter, it was quite impossible to use this method, as my glass tubes were limited to 5 feet long, and the difficulty of telling the exact moment of crossing a mark introduced too great an error in a short time interval. I therefore decided to measure velocities, exceeding such as could be dealt with by eye and stop-watch, in some other way. I first worked out a method by which an upward current might be generated in a large glass tube, and its velocity varied and measured; it was intended to place particles of different diameters in this current, and to vary its velocity until each particle was just kept in suspension, and then to take the velocity of the current as a measure of the rate of fall of the suspended body. On going carefully into the question, I came to the conclusion that the method could not give sound results, because of irregularities

* Research Department, February 22, 1910.

in the velocity of the current, and the fact that it would be more rapid at the centre than at the sides, so that it would have been impossible to tell the true velocity of the part impinging on and supporting the body under test.

I then worked out the photographic method which was actually used in the experiments, and which gave very satisfactory results. This was based upon the following idea :—

If a series of instantaneous photographs of a body falling through water in a glass tube could be taken on the same plate, and if the intervals between the exposures were equal and known, then, provided a scale was marked on or fixed beside the tube, the velocity would be equal to the interval between two images measured on the scale divided by the time between exposures.

The chief difficulties were : (*a*) to get exact and known time-intervals between exposures ; (*b*) to prevent the subsequent exposures destroying the images already taken higher up the tube ; and (*c*) to start the body falling and shutter moving simultaneously.

To get exact time intervals between exposures, a pendulum shutter swinging in front of the lens of the camera was used. This shutter was shaped like the segment of a ring, and had a long radial slot in the middle, which swept over a similar slot in a disc of metal fixed in front of the lens. The pendulum was worked by a clock, and gave exposures at intervals of 0·265 sec. I first made each slot $\frac{1}{16}$ inch wide, giving $\frac{1}{120}$ of a sec. exposure ; but this was found to be too short, and the plates were badly under-exposed. I then increased one slot to $\frac{1}{4}$ and the other to $\frac{1}{8}$ inch wide, giving $\frac{1}{30}$ sec. exposure, and this gave better results ; finally, each slot was made $\frac{1}{4}$ inch wide, and this worked very well. The slots in pendulum and lens were each $\frac{3}{4}$ inch long. The interval between exposures was got by counting the number of swings made in 5 minutes.

To get over the next difficulty, the glass tube, which was $2\frac{1}{2}$ inches in diameter, was fixed in a stand painted dead black, and so shaped that when placed in the sun the background could be kept in the shade and the tube in the light. By doing this it was found that the repeated exposures of the same plate did not injure the images near the top of the tube.

I hoped that the gradual growth of velocity of a body falling through water to a constant maximum value would be shown on the photographs, if the body could be started falling and the pendulum swinging simultaneously. In starting the body from rest, I found that it was most difficult to avoid giving it a movement of rotation at the moment of release. For example, if released from the finger and thumb, or in any way by which the last contact before falling was with the sides of the body, it was sure to revolve on a horizontal axis, owing to the contact being longer on one side than the other, and this rotation gave the body an erratic course from side to side of the tube, even when it was a spherical ball. I therefore came to the conclusion that the last point of contact before release should be vertically over the centre of the ball. The following was the means finally adopted :—

A cap was made of metal to fit the top of the large glass tube ; in the centre of this cap was a hole which could be closed by a perforated cork, and through the cork a small glass tube was passed. On the lower end of this tube a small india-rubber sucker was fixed ; the upper end of this small glass tube was connected to a long rubber tube, the other end of which was fixed to a small pneumatic trigger release on the pendulum stand. When the air was sucked out of this tube through a T-piece in the middle, a ball placed on the sucker adhered to it, and at the same time the pneumatic trigger on the pendulum shutter was raised so that the pendulum could be brought to the limit of its swing on one side and held there by the trigger. A spring clip on the T-piece kept it closed when the air had been sucked out ; so that the sucker and ball could be placed in position in the large glass

tube, and the ball adjusted to the zero on the scale by sliding it up or down. When the camera was ready, the clip on the T-piece was pressed. This admitted air to the ball and trigger, and started the ball falling and pendulum swinging simultaneously.

When steel balls or phosphor-bronze were used the spot of light reflected from the ball acted on the plate, and so gave a series of black dots or short streaks on the negative. The fast-moving metal balls gave short streaks, and the intervals were measured from the same point in each streak; pebbles and marbles gave dots, as they moved more slowly. In all cases the top edges of the dots were taken to measure the interval fallen through.

Turning now to the results of the photographic experiments, these are shown in Table II.

In all cases the photographs showed a series of equidistant dots or short streaks occupying the lower part of the tube: and in some it was found that the dots representing the falling body were shown with gradually increasing intervals between at the upper end of the tube, thus showing the accelerating stage of the motion. This did not come out very clearly for two reasons: one being that this stage was so very short that there were only two or three images obtained before the uniform rate of fall was established: and the other was due to the fact that light was reflected from the upper end of the tube in all cases, and this obscured the first few images in many. Of course, had the shutter used given ten exposures per second instead of about four it would have brought out this accelerating stage better, as there would have been a greater number of images. It was considered, however, of more importance to obtain the uniform rate of fall, and in this, as in many other things throughout the experiments, I was handicapped by having to utilize the means at my disposal and prepare all the apparatus myself. The photographs, however, show clearly that there are two stages in the fall of a body from rest through water. A first short accelerating stage, followed by a stage of steady fall at a uniform velocity.

In considering the rate of fall of balls and shingle particles it will be convenient to take the photographic and other experiments together. In order to obtain the law governing the fall of bodies in water, it was considered advisable to begin with experiments on spheres and follow these up with others on shingle particles. For the former steel, phosphor-bronze and stone balls were used in the first instance; but later it was found that, to get increased accuracy of observation, balls of a specific gravity only slightly greater than water were required. These were prepared as follows: A mixture of paraffin wax and powdered chalk was made so that it would just sink in fresh water, balls of various diameters were made from this and placed in a solution of common salt which floated them; to this fresh water was added until the balls neither floated nor sank, and the sp. gr. of the solution taken with a hydrometer; this gave the sp. gr. of the balls. They sank so slowly through the water that it was easy to time their fall with a stop-watch; but care had to be taken to prevent the adhesion of air-bubbles to the wax balls, since the water did not wet them as with other materials. Glass tubes about 5 feet long and from $\frac{3}{4}$ inch to $2\frac{1}{8}$ inches diameter were used; these were filled with water, a mark placed about a foot from the top, and another 4 feet below this. The time taken for a body to fall from one mark to the other was noted by a stop-watch.

It was next necessary to find what was the largest-sized body which could be used in such tubes without an appreciable error being introduced by the proximity of the walls of the tube. Two methods were utilized to obtain this result; one based on the presumption that if balls of gradually increasing diameter were timed in a small and a large tube, when the sides began to affect the rate of fall in the *smaller* tube this would be indicated by a difference in the rate of fall for the same

body in the two tubes. In this way a limiting ratio between the diameters of the falling body and the tube could be obtained, which should not be exceeded; this ratio was found to be about one to four. Again, for spheres large enough for viscosity to be neglected, the maximum constant velocity of fall in water can be obtained theoretically by equating the pressure of the current due to the velocity of fall on the projected area of the sphere, to its weight in water. If we call v the velocity in foot-sec., d the diameter of the sphere in feet, s the sp. gr. of the sphere, and k a constant depending on the shape of the body, etc., then the velocity will be given by the formula

$$v = k\sqrt{d(s-1)}$$

within fair limits of accuracy. Now, on timing a series of balls through a $\frac{3}{4}$-inch tube it was found that the value of k in this formula as obtained from the velocity observed, fell off rapidly when the ratio of ball and tube diameter became about 0·25 : 1. This is shown in Table I. Nos. 3, 4, 5, 8 and 9, k in col. 9 being reduced with the larger diameter balls.

TABLE I.

Velocity of Fall of Balls through Water.

Conditions of Experiments: Total fall of 5 feet. Ball timed over the last 4 feet of its path. Diameter of tubes, A, $\frac{3}{4}$ inch; B, $2\frac{1}{8}$ inches.

1	2	3	4	5	6	7	8	9	10	11
Reference number of balls.	Material of balls.	Specific gravity (s).	Weight of balls.	Diameter (d).	Tube used.	Time of fall. Mean of five observations.	Velocity of fall (v).	$\frac{v}{\sqrt{\frac{d}{12}(s-1)}}$	Temperature of water.	Remarks.
No.	—	(s)	grms.	ins.		secs.	ft. per sec.	k	° F.	
1	Steel	7·82	0·131	0·125	A	1·64	2·43	9·20	51	Specific gravity calculated for first nine balls from their weight and diameter.
2	,,	7·78	0·433	0·187	,,	1·33	3·01	9·26	51	
3	,,	7·78	1·477	0·281	,,	1·20	3·35	8·40	51	
4	,,	7·78	1·997	0·311	,,	1·16	3·45	8·25	51	
5	,,	7·79	8·2144	0·498	,,	1·40	2·86	5·44	49	Too big for tube.
6	Phosphor-bronze	8·41	0·402	0·177	,,	1·55	2·57	7·76	51	
7	,,	8·89	0·152	0·126	,,	1·40	2·86	9·93	51	
8	Stone	2·71	1·548	0·410	,,	2·82	1·42	5·88	51	
9	,,	2·64	0·5812	0·295	,,	2·30	1·75	8·70	51	Nos. 8, 9, and the wax ball were not perfect spheres.
10	Wax	1·19	—	0·146	B	10·08	0·396	8·24	51	
11	,,	1·19	—	0·176	,,	9·26	0·432	8·15	51	
12	,,	1·19	—	0·207	,,	8·66	0·462	8·07	51	
13	,,	1·19	—	0·260	,,	7·44	0·538	8·38	51	Specific gravity of wax balls determined by floating in salt water. Wax balls formed of paraffin wax and powdered whiting.
14	,,	1·19	—	0·317	,,	6·72	0·595	8·37	51	
15	,,	1·19	—	0·342	,,	5·80	0·690	9·33	51	
16	,,	1·19	—	0·388	,,	6·20	0·645	8·20	51	
17	,,	1·19	—	0·451	,,	5·04	0·794	9·36	51	
18	,,	1·19	—	0·494	,,	5·86	0·681	7·83	51	
19	,,	1·19	—	0·75	,,	6·28	0·640	5·85	51	Too big for tube.

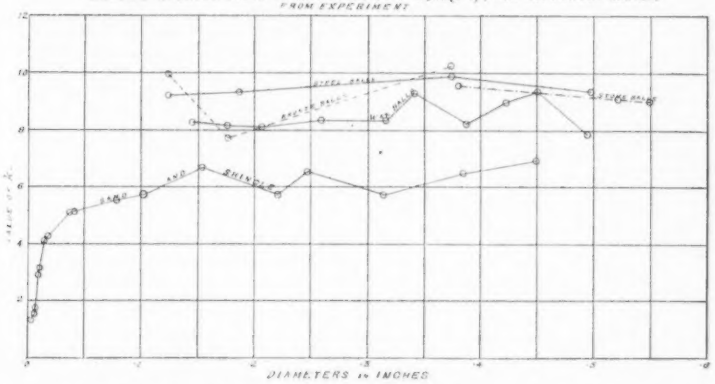
Now as to results: On plotting a graph of k in terms of the ball diameter it was found to be practically constant between 0·125 and 0·55 inch diameter, showing that if we knew what value to take for k the above formula would, for balls over a certain limiting diameter, give the true velocity or rate of fall in water. On applying the same formula to sand grains it was found, however, to break down completely; the value of k for grains below about 0·125 inch depended on the size of the grain. This is brought out in the curve in Fig. 1, which shows graphically the value of k for steel, stone and wax balls, and for ordinary pebbles and sand grains. The fact that this formula breaks down at a critical diameter shows clearly that the effect of viscosity and skin friction cannot be neglected for particles below about $\frac{1}{8}$ inch in diameter.

The results of these experiments are shown in Tables I., II., and part of Table III. The rates of settlement of spheres of various sp. gr. are also plotted as curves in Fig. 2. These are all for fresh water; as it was found that the difference between the rates of settlement in fresh and sea water was inappreciable, even for fine sand particles; as will be seen brought out in Table III. The utmost care was taken to keep the temperature of the water constant in these experiments.

On the whole it was found that for spheres of nearly perfect shape, such as were the steel and bronze balls and some of the stone balls, the maximum constant velocity of fall in fresh water was given with considerable accuracy by the formula $v = 9{\cdot}35\sqrt{d(s-1)}$.

FIG. 1.

CURVES SHOWING VALUE OF k IN FORMULA $v = k\sqrt{d(s-1)}$, FOR DIFFERENT BODIES, FROM EXPERIMENT



As the shape departed from a true sphere so the value of k became less, so that for the wax balls the velocity was given by $v = 8{\cdot}25\sqrt{d(s-1)}$.

The rate of settlement of ordinary particles of shingle above the diameter 0·125 of an inch is given by the expression $v = 6{\cdot}12\sqrt{d(s-1)}$.

TABLE II.

VELOCITY OF BODIES FALLING IN WATER; PHOTOGRAPHIC OBSERVATIONS.

Conditions of Experiments: Tube 2_8 inches diameter, 5 feet long, photographed beside vertical linear scale, as balls fell through the water, by means of an oscillating shutter.

1	2	3	4	5	6	7	8	9	10
Reference number.	Material of balls.	Specific gravity of balls.	Weight of balls.	Diameter of balls (d).	Fall.	Time of fall.	Velocity of fall (v).	$\frac{v}{\sqrt{\frac{d}{12}(s-1)}}$	Temperature.
No.		(s)	grms.	ins.	feet.	secs.	ft. per sec.	k.	° F.
20	Steel	7·76	3·4888	0·375	2·39	0·530	4·51	9·83	51·5
21	,,	7·77	8·207	0·498	2·637	0·532	4·96	9·38	50·5
22	Stone	2·62	3·185	0·522	2·69	1·060	2 53	9·55	51·5
23	,, *	2·60	2·047	0·451	2·70	1·596	1·70	6·92	50·5
24	,,	2·63	1·259	0·382	3·39	1·596	2·13	9·46	52·5
25	Wax *	1·19	0·7924	0·423	2 00	2·66	0 752	8 98	50·5
26	Stone	2·63	3·751	0·550	2·63	1·064	2·47	9·03	52·5
27	Phosphor-bronze	8·92	4·0184	0·375	2·69	0·530	5·08	10·20	51·5

Balls marked thus * were not perfect spheres.

TABLE III.

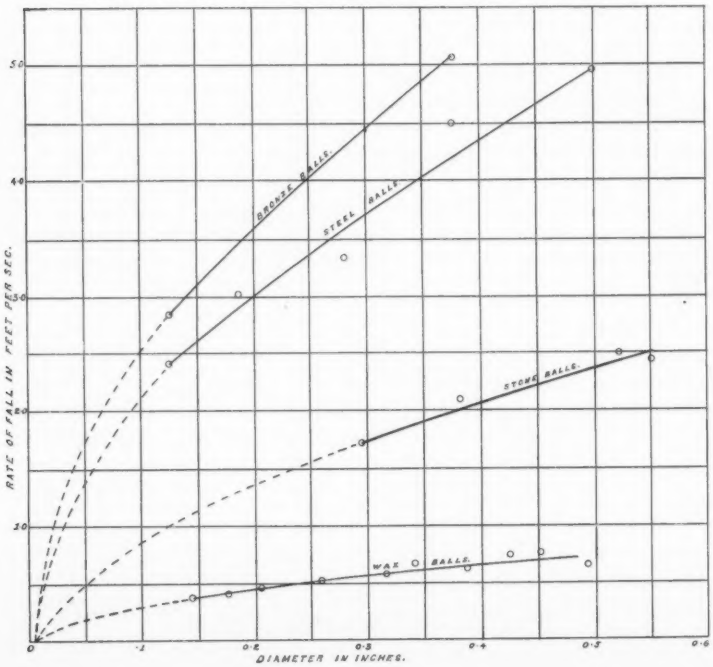
RATE OF SETTLEMENT OF SAND PARTICLES IN FRESH AND SEA WATER.

Conditions of Experiments: Tube ¾-inch diameter for Nos. 1 to 11; 2⅛ diameter for Nos. 12 to 16. Total fall 5 feet, single grain timed over last 4 feet.

Particulars *re* sand-grains.				In fresh water.				In sea water.		
1		2	3	4	5	6	7	8	9	10
Reference number.		Specific gravity (s).	Diameter.	Time of fall through 4 feet. Mean of five observations.	Velocity.	$\sqrt{\frac{v}{\frac{d}{12}(s-1)}} = k.$	Temperature of water.	Time of fall through 4 feet. Mean of five observations.	Velocity.	Temperature of water.
No.		s.	ins.	secs.	feet per sec.	k.	° F.	secs.	feet per sec.	° F.
Fine sand	1	2·61	0·00315	150 8	0·0266	1·278	51·5	152·2	0·0263	51
	2	,,	0·0055	95·2	0·0420	1·550	,,	92·4	0·0433	,,
	3	,,	0·0061	80·6	0·0496	1·767	52	80·0	0·050	,,
	4	,,	0·0097	38·0	0·105	2·91	51	—	—	—
Medium sand	5	,,	0·0120	31·9	0·125	3·13	,,	31·4	0·127	51
	6	,,	0·0150	21·8	0·184	4·10	,,	21·0	0·190	,,
	7	,,	0·0188	19·0	0·213	4·25	,,	17·6	0·225	,,
Coarse sand	8	,,	0·0370	11·2	0·357	5·07	,,	9·8	0·410	50
	9	,,	0·0425	10·4	0·384	5·08	,,	—	—	—
Shingle	10	,,	0·0800	7·0	0·572	5·53	,,	7·2	0·553	51
	11	,,	0·1030	6·0	0·665	5·66	,,	6·4	0·626	,,
	12	,,	0·1550	4·14	0·970	6·72	50	—	—	—
	13	,,	0·2210	4·06	0·980	5·73	,,	—	—	—
	14	,,	0·2480	3·34	1·200	6·58	,,	—	—	—
	15	,,	0·3150	3·40	1·18	5·76	,,	—	—	—
	16	,,	0·3850	2·74	1·46	6·50	,,	—	—	—

FIG. 2

RATE OF FALL IN WATER OF SPHERES OF DIFFERENT MATERIALS.



Here, however, we meet with considerable difficulty in connection with the diameter. The diameters given for particles 12 to 16 in Table III. are obtained from their weight, and really represent that of a sphere of equal weight; the same applies to the d in the formula. This was done to bring them into line with the bodies previously mentioned; but is, I feel sure, not the best value to take, chiefly because there appears to be a very remarkable tendency for all irregularly shaped bodies to fall through water with their greatest projected area horizontal.

Experiment 2.

The Settlement of Sand Grains through Water.

In this experiment a number of samples of sand, chiefly from the sea shore, were taken and graded by passing through sieves varying in mesh from 140 per lineal inch with 0·004 inch diameter wire up to eight meshes to the inch with 0·022-inch wire. This gave eleven different sized grains, the smallest being 0·00315 inch diameter and the largest 0·103 inch. Each graded sample was placed in a glass tube and labelled with a specimen number, and the maximum and minimum sized particles contained. Great difficulties were met in carrying out this experiment from various causes, and an account of these difficulties and the methods adopted for surmounting them may be of use to others who wish to experiment; it will also show how many are the possibilities of error, and serve to account for discrepancy in the results of different observers.

In the first place, having graded the sand between two sieves of slight difference in mesh, it was thought sufficient to select from a small heap of graded sand such a particle as appeared fairly regular in shape and of about the average diameter and density, and it was hoped that by making a large number of observations on the rate of fall error would be eliminated and a fair mean arrived at. After a number of trials along these lines it was found that the variation in time of settlement was too great to promise any useful results. This method was therefore abandoned in favour of the following:—

A very small quantity, perhaps including 100 grains of the small-sized sands, was damped, to avoid air-bubbles adhering, and introduced into the tube of water. The middle grains of the group as it fell were timed over the measured distance in the hope of obtaining a mean rate of fall. The results obtained in this way were quite inconsistent, and it was found impossible to get the mean time of the fall for the sand for two reasons.

First, owing to the stringing out of the grains as they settled, the choice of a grain about the middle of the column left too much opening for personal error. Also it was found that the leading grains of the group set up eddies and currents in the water which accelerated the fall of those behind. The latter point was brought out in two curious ways. In certain cases, where one particle was followed closely by another in its descent, the following grain would make frequent downward rushes on to the back of the leading one. These rushes were quite remarkable, and were repeated regularly during the entire descent. The grain which was behind would hover for a moment and then pounce down on the one in front, and in some cases took up a position on the back of the leader and remained there for the rest of the descent. Again, two samples of sand similarly graded were timed, and, for the purpose of timing, the silicious grains were chosen in each, and the leader of the group of such grains taken. One sand contained a large number of dark heavy grains, probably ironstone, and these sorted themselves out and fell in front of the silicious grains with this result: the silicious grains in the sample

containing no heavy ironstone grains fell slower than in the other, due, no doubt, to the fact that in the other they were falling in the wake of the heavier particles.

The method of timing the middle grains of a group had, therefore, to be abandoned, and that finally adopted was to take from each sample a small pinch of sand, drop it into the tube, and time the passage of the leading silicious particle over the measured distance. If the sand had been graded through, say, a mesh $\frac{1}{30}$ inch, and then through $\frac{1}{100}$ inch diameter, since the largest grains travel fastest, the leading grains of the group would necessarily be $\frac{1}{30}$ inch in diameter. This method was found to give remarkably consistent results. In each case five or more experiments were made for any grade of sand, and the average of the five taken. But the variation in the time of fall in such a group of five was always very small; in one case five consecutive observations gave exactly the same time to a fifth of a second. A refinement of this method was actually adopted; this consisted in taking a sample which had all passed say $\frac{1}{100}$ mesh sieve, and again passing it through the *same* sieve; in each case there was always a residue on the sieve which only passed after much shaking, and this was taken for the purpose of the test, as it contained grains of a nearly uniform size, and the leader was timed as described above. It was found that such a sample contained many grains which fell in a group, retaining their relative positions, showing that at last a means of getting the true rate for any particular grade of sand had been found.

As nearly all the samples were composed chiefly of quartz grains, these grains were always chosen for timing, as the specific gravity was known and constant. These experiments were conducted in a $\frac{3}{4}$-inch tube 5 feet long, held vertically in clips. A mark was fixed about a foot down the tube, and another 4 feet lower, and the passage of the grain timed between the two.

Thus, the water being level with the top of the tube, the sand grain had time to attain to its uniform rate of fall before reaching the top mark. The behaviour of the grains in falling varied with their shape, some fell steadily, some rotated on a vertical axis, and some darted about erratically from side to side as they fell. When dealing with the coarser sands a tendency for flat grains to fall with the flat surface horizontal was noticed, and consequently this was experimented on separately, and is described under Experiment 7. The irregularity in their behaviour was most marked in the hindermost grains, and was not noticeable at all in the case of fine grained-sands. Under 0·005 inch in diameter the sands settled steadily through the water without any apparent darting about of grains. This was probably due to the increasing effect of viscosity as the grains became smaller.

The result of the experiments on sand are included in Table III., with those referring to larger irregularly shaped particles of shingle, and a curve showing the velocities in terms of the diameter is given in Fig. 3. For the larger particles flint pebbles were chosen as having practically the same sp. gr. as quartz sand.

Referring to Table III., it will be seen that the rate of fall of sand in fresh- and sea-water is practically the same. The value of k in the formula $v = k\sqrt{d(s-1)}$ has been included in the table to bring out the point already referred to, that it is only for grains over about 0·125 inch in diameter that k attains a fairly constant value, and for which, therefore, the formula is of any use.

The curve in Fig 3 brings out graphically the very rapid falling off in velocity as the size of grain becomes smaller. The regular curve is simply drawn in to represent the average of the different observations, shown on or near the curve. What happens below the smallest diameter tested, that is, 0·00315-inch, it is difficult to say; but the curve certainly looks as if it would not pass through the origin. In other words, that the rate of fall becomes 0, while the diameter of grain is

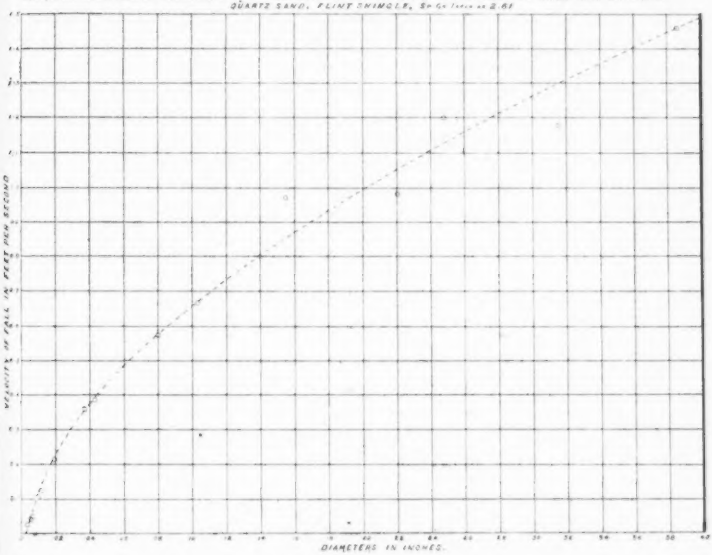
greater than 0; perhaps, when the effective weight of the grain is unable to overcome the forces opposing its fall, such as skin friction and viscosity. Should this be so, it means that when particles are sufficiently small they would remain permanently suspended.

For reasons which will now be given, I came to the conclusion that mere tests of the rate of settlement of mud of different degrees of comminution would be of little use, and in fact that no such rates could, with any regard for accuracy, be given, except for a particular sample under very rigidly defined conditions as to temperature, quantity present, degree of purity of the water, and others.

It would be manifestly impossible to time the rate of fall of a single particle of mud as in the experiments with sand and shingle, and if mud be shaken up with

FIG. 3.

EXPERIMENTAL CURVE SHOWING RATE OF SETTLEMENT IN WATER OF PARTICLES OF SAND AND SHINGLE.
QUARTZ SAND, FLINT SHINGLE, Sp. Gr. [illegible] = 2.61



water and placed to settle, it is almost impossible to say when settlement is complete, owing to the gradual clearing of the water. Obviously the time required for muddy water to clear depends upon the size of the *smallest* particles of the mud, which come down last; and, as mud contains a great assortment of different sized particles, this information would be of little value.

The time required for a fine mud to settle through any depth is considerable, and during this time slight variations in the temperature of the water may occur; in fact, it is difficult to prevent them without elaborate preparations; now there is little doubt that as the grain becomes finer, so the effect of temperature becomes greater, and would introduce serious errors owing to the length of time required for settlement of very fine mud. The effect of salts in solution in the water has been dealt with by several observers, and it has been shown that mud settles more rapidly in sea- than in fresh-water, notwithstanding its greater density; similarly, other salts, such as calcium chloride, in solution hasten the deposit of mud, probably

by reducing the viscosity of the water. The effect of light has also been dealt with. In fact, the field for observation in connection with the rate of deposit of mud appears to be limited to the outside factors which influence it. I have, therefore, thought it best to confine my experiments to one or two points which seemed to promise some interesting and perhaps valuable results. These will be considered under their respective headings.

Experiment 3.

Effect of Suspended Matter on the Density of the Water.

It appeared probable that as long as fine matter remained suspended in water, the effect upon the sp. gr. of the water would be the same as if the matter had gone into solution. Further, it seemed reasonable to believe that any material increase in the density or sp. gr. of the water would make a corresponding increase in its eroding power. The experiment was, therefore, made of mixing weighed quantities of whiting with a definite volume of water and taking the sp. gr. of the mixture with a hydrometer. The sp. gr. was also calculated, assuming the effect to be the same as if the whiting had gone into solution, and the figures obtained in each way compared. The result of this is set forth in Table IV., columns 4 and 5, from which it will be seen that the effect of the suspended whiting on the sp. gr. of the water was the same as if it had been dissolved. The theoretical and experimental figures for sp. gr. differ slightly, and this is no doubt due to the difficulty experienced of reading the hydrometer accurately in the turbid water.

TABLE IV.

Effect of Solid Suspended Matter upon the Specific Gravity of the Mixture and on the Rate of Settlement of Sand-particles through Water containing Matter in Suspension.

Conditions of Experiment: Volume of mixture of whiting and water kept constant at 200·5 c.c. Proportion of whiting varied. A constant quantity of sand shaken up in this mixture.

1	2	3	4	5	6	7	8	9
Reference number.	Weight of chalk in mixture.	Weight of water in mixture.	Sp. gr. of mixture. Chalk assumed in solution.	Sp. gr. of mixture as indicated by hydrometer.	Per cent. by weight of chalk relative to water.	Chalk as a per cent. by volume of water.	Time of settlement of sand.	Temperature of mixture.
No.	grms.	grms.			Per cent.	Per cent.	Secs.	° F.
1	—	200·5	1·0	1·0	—	—	38·6	49
2	10	197·15	1·034	1·03	5·19	1·74	44·8	48
3	20	193·80	1·066	1·06	10·4	3·49	53·4	49
4	30	190·45	1·10	1·08	15·7	5·26	74·8	49·5
5	40	187·10	1·13	1·13	21·4	7·17	122·8	52

The experiment was also tried with fine sand instead of whiting, and the effect was similar, only the sand settled so rapidly it was difficult to get the maximum reading of the hydrometer. In one case, however, with a large amount of sand shaken up into suspension a reading of 1·4 was got. Of course, there was an exceptionally large amount of sand present; but I question if there was more than can sometimes be seen sweeping along in the bottom layers of a current flowing

over a sandy bed. Even a slight increase of density of the water has a great effect on its power of moving heavy bodies by rolling along the bed. The diameter of stone which a current can roll over a sandy bed may be obtained from the following expression, taking the sp. gr. of the water into account:—

Let w = sp. gr. of water,

s = „ „ stone,

v = velocity of current in foot-secs.,

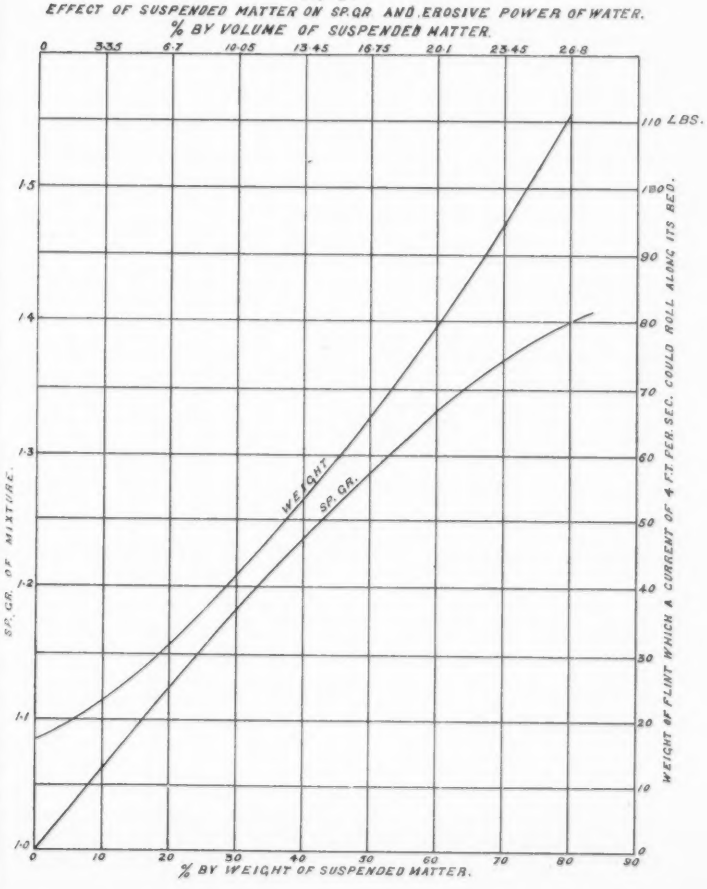
d = diameter of stone in inches,

then $$d = \frac{0{\cdot}7v^2}{s - w}, \text{ approximately.}$$

The weight of the stone can be obtained from this, and for flints may be taken as $= 0{\cdot}05d^3$.

Referring now to Fig. 4, this shows two curves, one of which gives the sp. gr.

FIG. 4.



of a mixture of mud and water, assuming that the effect is the same as if the mud had been dissolved; the percentage of mud or whiting which was actually used is given by weight on the bottom scale and by volume on the top, the sp. gr. corresponding to any percentage being read from the left-hand scale.

The second curve shows the weight of a flint stone which a current of 4 feet per sec. velocity could roll along. This is obtained from the above formula. The weight corresponding to any percentage of suspended matter as given on top or bottom scale is to be read off on the scale on the right of the curve. It will be seen from this that when the sp. gr. is raised to 1·4, the weight of flint which can be moved is about five times as great as for pure water. As it is only the bottom layers of a current which come in contact with stones on its bed, it would seem that this factor should not be neglected in considering the erosive power of a current.

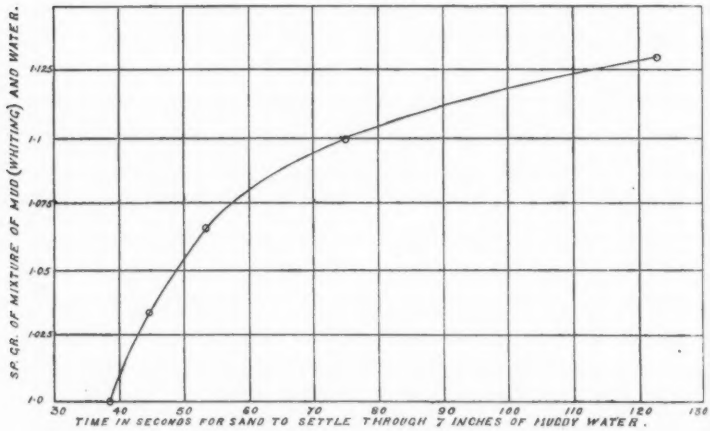
Experiment 4.

Effect of Fine Suspended Matter on the Rate of Settlement of Coarser Sand.

As it seemed probable that the presence of mud in water, since it increases its density, must also affect the rate of settlement of sand-particles through it, the following experiment was made to bring out this effect:—

FIG. 5.

EFFECT OF DIFFERENT PROPORTIONS OF SUSPENDED MUD ON RATE OF SETTLEMENT OF FINE SAND.



A mixture of whiting and water was made and placed in a tall glass vessel; into this a certain quantity of sand was put, sufficient to make a layer on the bottom about an inch deep. On shaking up the sand with the whiting and water and placing to settle, the termination of the process could be easily noted by observing the layer of sand formed on the bottom; when this reached a mark placed on the glass, to show its depth when all had been settled, the time was noted. The sand having been first shaken up with clear water to obtain its time of settlement under these conditions, it was then shaken up with water containing definite weighed quantities of whiting, and the time of settlement noted. The results are given in Table IV., the percentage of whiting in the water in columns 6 and 7, and the time of settlement of the sand in column 8. These results have been plotted in a curve in Fig. 5, the sp. gr. of the mixture as ordinates, and the

time of settlement of the sand as abscissæ. It will be noted that the curve is very regular and that the influence of the suspended matter is very great. Of course, the quantity in suspension is very great and not likely to be met with in nature except under extraordinary conditions. At the same time, if, for example, there is a layer of very muddy water flowing in contact with a river-bed, it might not only exercise a more powerful erosive action, but would also retard the fall of any particles reaching it from above, and they would consequently be carried further downstream than in less muddy water.

Experiment 5.

On the Formation and Rate of Fall of a "Surface of Separation" in Muddy Water, and on the Effect of the Quantity of Suspended Matter present on its Rate of Settlement.

In working with finely divided matter, such as whiting or mud, it was found that the way in which it settled through water depended upon the amount present. The experiment was conducted in a tall glass cylinder about 1¼ inches diameter and 13¾ inches high; when the quantity of whiting added to the water in this vessel was small, under say 1 per cent. by weight, it settled by a gradual clearing of the water. As the quantity was increased a tendency became apparent for the liquid to be divided into a clear upper and a turbid lower portion, separated, however, by a very ill-defined part where the turbid shaded off into the clear. When about 6 per cent. by weight was added, the same process went on for a while, but at *some* point in the vessel or tube a change occurred at the junction of the clear and turbid parts by which a perfectly defined surface of separation was formed, all above this being clear water or practically so, and below it muddy. When the quantity of whiting added reached 10 to 12 per cent. of the water, a surface of separation such as described was formed from the moment the liquid was placed to settle after being shaken up.

TABLE V.

Formation and Rate of Settlement of Surface of Separation in Muddy Water.

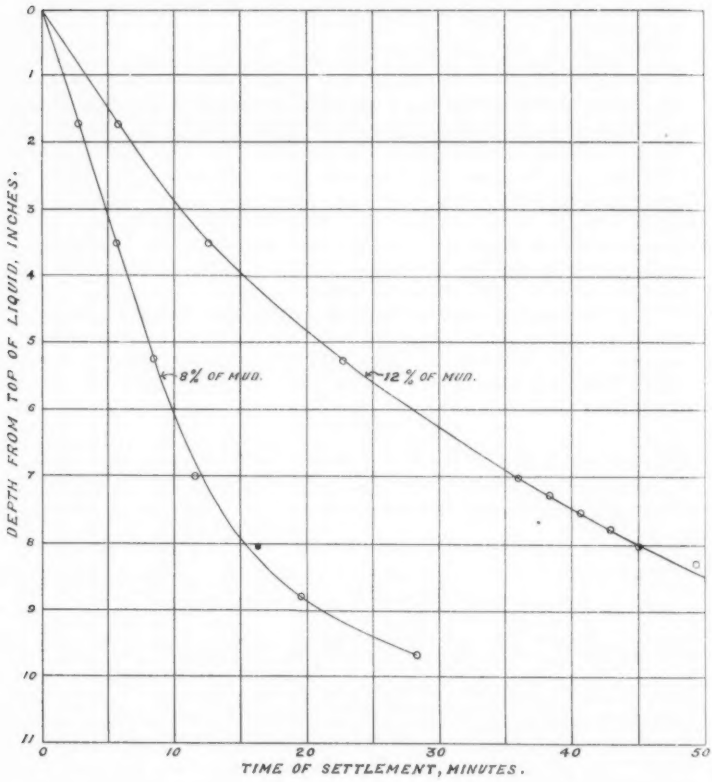
Conditions of Experiment: Varying quantities of chalk suspended in 350 grammes of water. Temperature about 53·5 throughout.

1	2		3	
Distance of surface of separation from free surface of water.	Time of arrival of separation surface at the points in column 1; 28 grms. chalk in suspension. Percentage of chalk by weight = 8.		Time of arrival of separation surface at points in column 1; 42 grms. of chalk in suspension. Percentage of chalk by weight = 12.	
Ins.	mins.	secs.	mins.	secs.
0·0	—	—	—	—
1·75	2	45	5	55
3·50	5	30	12	40
5·25	8	15	22	35
7·00	11	30	35	50
7·25	—	—	38	13
7·50	—	—	40	30
7·75	—	—	42	45
8·00	—	—	44	59
8·25	—	—	49	10
8·50	—	—	—	—
8·75	19	30	—	—
9·6250	28	15	—	—

Table V. is prepared from two experiments, one with 8 per cent. and one with 12 per cent. of fine whiting shaken up in water. The glass cylinder was divided by marks placed at the points shown in Col. 1. In Cols. 2 and 3 are given the times of arrival of the surface of separation at the points given in Col. 1. It will be noticed that the surface settled more slowly in the vessel containing the larger quantity of whiting; also that, as the surface neared the bottom, the rate of settle-

FIG. 6.

SETTLEMENT OF "SURFACE OF SEPARATION" IN MUDDY WATER, SHOWING REDUCED RATE AS THE MUD BECOMES CONCENTRATED NEAR THE BOTTOM, ALSO WHEN QUANTITY OF MUD PRESENT IS INCREASED.



ment became slower. It is, I think, therefore, clear that the reduced rate near the bottom was due to the concentration of the suspended matter. This is brought out in a more striking way in Fig. 6 in which curves, showing the rate of settlement for these two percentages, are plotted. The result is analogous to that in Experiment 4, where sand was allowed to settle through muddy water with different proportions of mud present.

It has been shown in Experiment 3 that suspended matter raises the density of the liquid, and in 4 and 5 that this results in a slower rate of settlement of particles in the denser liquid. It is in this, I think, we can find the explanation of the curious phenomenon which I have called the "surface of separation."

The particles of matter suspended in the water are not all of uniform size, some are small compared with others, and the smaller particles would settle slower than the larger ones, if in a liquid of the same density. When there is very little matter in suspension the liquid is practically of the same density throughout, and the large particles will fall quickly away from the small ones, and settlement will be almost a gradual clearing of the whole column of liquid. If the amount of suspended matter is sufficient to affect the density materially, then the coarser particles, falling away from the surface of the liquid, increase the density of the lower layers and therefore reduce the rate of settlement in these layers. Now it is obvious that if any particular layer has its rate of fall so reduced that it can be overtaken by the finest of the particles falling through the less dense upper layers, we then have the conditions for the formation of a definite surface to the muddy bottom liquid, and such a surface will form, as shown by Experiment 7 at some point between the top and bottom of the liquid.

When sufficient solid matter is added to the liquid in the first instance to sufficiently reduce the rate of settlement of the particles from the normal in clear water of the same temperature, there must from this cause be a levelling down of the rates of settlement of the particles at the free surface of the muddy liquid; so that in such a liquid particles of different size, if they happen to be at the free surface when settlement begins, will all settle at the same rate, and so remain at the same level.

It may be thought that experiments in which quantities of suspended matter of 6 and 12 per cent. of the weight of the water are dealt with will have no practical bearing; but I cannot help thinking that, keeping in view the reduced rate of settlement due to concentrating the load of suspended matter as it settles, such loads may not be so uncommon as is believed. It seems to me that this experiment and also Nos. 3 and 4 all lend probability to their being a form of mud and sand-transport in a highly concentrated layer over the very bottom of river and sea-beds. I do not now refer to heights of a foot above the bed, but rather to layers of perhaps only a fraction of an inch thick, and I do not think we have any reliable data as to what goes on so close to the bottom, or samples of water taken from such a height above a muddy bottom.

When a small quantity of fine sand was shaken up in water in a tall glass vessel and its time of settlement noted, it was found that on increasing the amount of sand its time of settlement became greater. In other words, the more sand present in the water, the slower it settles to the bottom. I think one may assume that the rate of settlement of a sand-grain is also a measure of the velocity of upward current which would be capable of holding that grain suspended. This being so, it would seem to follow that a *slower* upward current would be required to support a concentrated load of sand than a more scattered load. That is to say, that in water it would require a greater disturbance to lift sand and keep it thinly distributed through the depth than would be required to support in suspension a heavier load. There would doubtless be more energy expended by the water on the sand in the heavier load; but this may only mean that energy is wasted by the current in supporting the scattered load, since the upward disturbance is not limited to the part of the fluid actually supporting the sand-grains. This all seems as if it must have a far-reaching effect in governing the transport of sand in suspension. For example, the following appears to be a legitimate inference: in a current

flowing over a sandy bed, the swirling and irregular motions in the water, to which the suspension of particles of a higher specific gravity than water is due, must be greater near the bottom than near the surface; hence, if from any cause—for example, a very irregular piece of bottom, or an increase of velocity due to narrows—sand be churned up in the current, it would, on arriving at less disturbed water, settle more rapidly in the upper parts of the current than near the bottom, and there might, therefore, be a concentrating of the sand in the bottom layers which would help to keep it suspended, since the more sand present in these layers the more marked would be the reduction in rate of settlement of any particular grain as it fell from the surface to the bottom. Thus a sort of cumulative action would be established tending to result in the formation of concentrated layers of suspended matter flowing close to the bottom.

Something of this nature actually happens in the case of a current flowing over fine sand when it exceeds a velocity of about 2·5 f.p.s., as was referred to in my paper of November, 1907.

Again, it would seem to follow, also, that a current which is incapable of picking up sand and lifting it grain by grain from the bottom, might be quite capable of holding it in suspension in considerable quantities if provided with already suspended sand. The point is one which will, I hope, be dealt with in the discussion, as the result of the experiment leads to rather anomalous conclusions.

Turning back for a moment to the rate of fall of the surface of separation between the clear and muddy water. As has been noted the nearer the surface of separation draws to the bottom the slower does it settle. There appears, however, to be a certain point at which settlement entirely ceases, although the layer of mud has not contracted to nearly so small a volume as it would occupy dry; in other words, there is a point in the settlement of mud when the weight of the particles is unable to penetrate the film of water which separates them, and when, therefore, settlement apparently ceases. No doubt, when there is a considerable depth of mud the lower layers are more compressed than the upper. This seems to be the condition in which mud exists on the beds of muddy rivers and in ponds.

Experiment 6.

Effect of Temperature of Water on Rate of Settlement.

This experiment was somewhat difficult to carry out. It was decided to work with very finely divided materials, as being most likely to bring out any alteration in the rate of settlement due to changes of temperature in the water. When, however, fine mud was placed to settle it was found impossible to keep the temperature moderately uniform, owing to the great time required to settle; and further, the moment when settlement was completed could not be accurately determined. The attempt to work with mud was abandoned, and very fine sand, which had passed a sieve of 140 meshes per lineal inch, was tried, a small quantity being shaken up in a glass tube and placed to settle; but still the end of settlement was very ill-defined, and no good results could be obtained.

I finally settled on a method similar to that used in Experiment 2, a very small quantity of the 140-mesh sand being placed in the water in a tall glass vessel, and the fall of the leading grains between two marks timed. This worked fairly well for low temperatures, as there was little change of temperature during the test, and the time of fall could be taken accurately with a stop-watch. At the higher temperatures there was still a considerable variation in temperature between the start and finish of each test. About five observations at each temperature were obtained, and these are shown in Table VI. The curve in Fig. 7 shows graphically

the same results. It will be seen from these that as the temperature of the water rises there is a corresponding rise in the rate of settlement. Although the experiment deals only with grains of a certain size, it brings out the effect clearly. It would no doubt be still more marked for smaller grains.

TABLE VI.

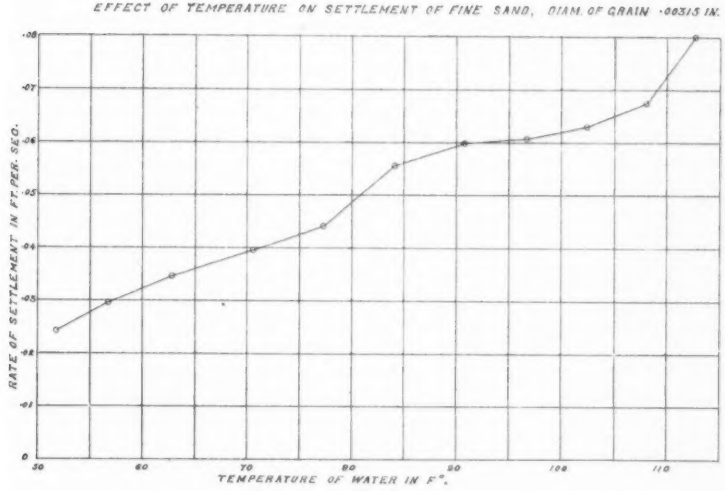
EFFECT OF TEMPERATURE ON RATE OF SETTLEMENT OF SUSPENDED MATTER.

Conditions of Experiment: Silt graded to a diameter of 0·00315 inch. Tube 1½ inch diameter. Depth of water in tube 13·25 inches. Leading grain timed over the last 9 inches of the fall.

0	1	2	3	4	5	6
Reference number.	Initial temperature of water.	Final temperature of water.	Mean temperature during deposition.	Time of deposition. Mean of five observations.	Mean rate of deposition of 0·00315 inch diam. grain.	Remarks.
No.	° F.	° F.	° F.	secs.	feet per sec.	
1	—	—	51·6	30·5	0·0246	
2	57·0	56·6	56·8	25·1	0·0298	
3	63·0	62·5	62·75	21·7	0·0346	
4	—	—	70·5	19·0	0·0395	
5	78·5	75·8	77·1	17·0	0·0441	
6	—	—	84·0	13·6	0·0552	
7	92·6	88·5	90·55	12·6	0·0598	
8	99·0	94·0	96·5	12·4	0·0603	
9	104·5	100·0	102·25	12·0	0·0625	
10	110·5	105·5	108·0	11·2	0·0670	
11	116·0	110·5	112·75	9·3	0·0805	

No observations could be recorded at higher temperatures owing to convection currents in the water.

FIG. 7.



A curious difficulty occurred in dealing with the higher temperatures where there was a rapid loss of heat through the sides of the vessel. I could distinctly

observe a central upward current surrounded on all sides by a downward one at the sides. These currents either retarded or increased the rate of fall of a sand grain according to which it happened to be in, and hence with the higher temperatures the results are not so consistent as with the lower. This suggested to me, since in nature we probably never find a large body of water of a perfectly uniform temperature, that it does not always follow that a rise at one part will mean an increased deposit of silt, convection currents would be set up and they interfere with the temperature effect. I have no doubt, however, that the rate of deposit of fine matter is on the whole more rapid in summer than in winter, and in warm climates than in cold. It must at the same time be remembered that an increased rate of settlement implies a smaller initial load of suspended matter, for the load which a current can carry or stir up must depend to a great extent on the rate of settlement of the material suspended.

Experiment 7.

Method of Settlement as determined by Shape of Body.

A mixture of wax and whiting, which had a specific gravity of about 1·2, and settled sufficiently slowly through water to be followed carefully by eye, was made, and from this particles of different shapes were moulded and dropped through water.

Discs were tried first; they were from $\frac{1}{2}$ to $\frac{1}{8}$ inch diameter. All were placed in the water edgewise one by one, and all immediately turned round so that the flat surface was horizontal, and settled steadily to the bottom in this way. Rods of different length were next tried, round in cross-section and of a length of about 10 to 20 diameters. These were placed endwise in the water, that is, with the greatest length vertical, and all turned at once so as to have the greatest length horizontal, and settled in this way. Flat rectangular pieces were then tried, that is, pieces having three different diameters, length, breadth and thickness; these were placed in the water with their length vertical, and all turned at once so as to have their length and breadth horizontal, and settled to the bottom disposed thus.

It will be noticed that the behaviour of all three shaped bodies had this in common: they settled to the bottom with the *greatest* possible surface horizontally disposed; and this is clearly, therefore, the normal disposition of a body falling through water. Contrary to what we would expect, such a body does not obey the law of "following the line of least resistance;" but, not content with disobeying it, even searches out the position of greatest resistance to its fall, and disposes itself in this position. The behaviour of disc-shaped bodies when rolled over a smooth hard bottom by a current of water was referred to in my previous paper, of November, 1907. And it was shown that their normal method of progression was by rolling on their edges on the bottom with their *smallest* surface exposed to the current. It is curious, therefore, to compare their behaviour with that of the bodies falling through water.

As to the importance of this from a practical point of view, if all bodies falling through water consistently oppose their greatest surface to the upward impact of the water due to their own velocity, this means that it is the greatest dimensions of a body, and not the average or least, which must be taken into account in considering its rate of fall through water. Perhaps in this tendency for particles to fall on the flat lies the explanation of some of the problems in connection with lamination in sedimentary rocks.

Turning now for a moment to seek for an explanation: it has been shown that for square planes the centre of pressure due to a current striking obliquely is not

coincident with, but in advance of, the geometric centre; but is coincident for a normal current. Now, if such a plane be allowed to fall through water, if not initially horizontal the centre of pressure due to the current will not be directly under the geometric centre, which for a symmetrical body will be its mass centre, or the point at which the downward force due to its weight acts; but slightly in advance, or nearer the leading edge; hence, there will, in such a case, always be a force tending to restore the plane to a horizontal position, in which the pressure and geometrical centres coincide. The normal method of fall must, therefore, be in the horizontal position. That some such reason as this applies to particles of sand and stone is probable. Perhaps in this tendency for particles to fall on the flat lies the explanation of some of the problems in connection with lamination in sedimentary rocks.

The following letter from Mr. N. F. MacKenzie was read: I am very sorry I cannot attend the Research Department meeting on Tuesday. I have a proof of Dr. Owens's paper, and it is evidently a most valuable contribution to a subject which irrigation engineers, at any rate, have done little to elucidate.

I should like to make a few remarks by way of confirmation on a point which Dr. Owens apparently thinks is not fully brought out by his experiments. He says, "A current which is incapable of picking up sand, grain by grain, might be quite capable of holding it (the sand) in suspension in considerable quantities." This is a fact well known to irrigation engineers, and is one of the factors governing the design of irrigation channels.

Mr. Flynn, in his book on 'Irrigation Canals,' notes that the silt-*eroding* power of water varies as the square of the velocity, while the silt-*transporting* power of water varies as the sixth power of the velocity. Unfortunately he gives no clue to the data on which this result is based. If the statement be correct as regards the silt-transporting power of water, it is interesting, as this is the only case, so far as I know, in which the sixth power of a variable occurs in nature. Many irrigation channels are designed with a very steep slope at the head of the channel, to scour out silt deposited when the volume of water was small; and once the silt has been picked up by the high velocity induced by the steep slope, it is carried forward by a much smaller velocity, and therefore the slope of the channel is flattened out lower down. It is important in irrigation channels that silt should be carried forward, and not deposited in the channel bed, and the slopes are arranged to secure this result.

Should Sir William Garstin be present at the meeting, he may be able to cast his memory back some thirty years to the irrigation channels in the Cawnpore division in India, where I was his assistant, and where we constructed our distributaries on this principle, which was first propounded by Colonel Justin Ross, afterwards one of Sir William's colleagues in Egypt.

In very general terms, a velocity of 2·5 or 3·0 feet per second will pick up silt in alluvial soils; and a velocity of 1·5 or 1·75 feet per second is sufficient to carry forward that silt once it has been picked up.

Might I suggest to Dr. Owens a further field for research, viz. the laws governing the deposition of suspended matter in running channels. Since the experiments of Mr. R. G. Kennedy in 1894, we have no data, and anything bearing on this point is of great value to irrigation engineers; it is, perhaps, the most important factor governing the design of irrigation channels. I should like to express to Dr. Owens my appreciation of his most interesting paper.

Dr. Vaughan Cornish: Dr. Owens's experiments have been devised with due regard to natural conditions, and carried out with every refinement; and his

tables of rates of settlement through water are likely to be the standard of reference for a considerable time to come. I suggest that in addition to reference numbers, a description of the samples of sand should be added in a parallel column, using the classification into fine, medium, coarse, etc., in accordance with the sizes specified for those descriptions in the paper of Mr. J. A. Udden on the "Mechanical Composition of Wind Deposits." If Dr. Owens would make a careful determination of the rates of subsidence of these sands in air he would confer a boon on all who are interested in the study of the transport and deposition of blown sand.

I wish to draw attention to the significance of Dr. Owens's experiment which shows that sand settles more slowly in muddy or sandy than in clear water. This throws light on the sudden change in the behaviour of the sandy beds of streams when the bottom current surpasses a velocity of about 2½ feet per second. The increased erosion is accompanied by diminished deposition, and the condition for the spontaneous production of sub-aqueous sand-waves by the continuous action of the current appears to be attained.

With regard to Dr. Owens's observation that stones subsiding in water present the greatest horizontal surface, but in rolling tend to get on their edges, may I refer to my paper in the *Geographical Journal* for May and June, 1898, where I endeavour to explain on that principle the accumulation of the flatter stones at the highest levels of a shingle beach?

Dr. STRAHAN: I was much struck by a remark made by Dr. Owens at a former meeting of this department on the effect of suspended matter in increasing the erosive power of water, and I then anticipated some further work from him on this subject.

I confess to finding it difficult to believe that the descent of a pebble in a tube is not retarded when the diameter of the tube is only four times that of the pebble. Specific gravity is another important factor to be taken into account. I notice that Dr. Owens took the specific gravity of some of the pebbles, but I do not know if he took that of the sand? It would be easy to get a number of sand grains of uniform and known specific gravity by means of a specific gravity solution. With regard to matter remaining suspended in water, I saw not long ago some water from a deep well in Lincolnshire in which fine silicious matter appeared to be suspended permanently. At any rate, the sediment showed no signs of settling after some weeks, and it was only after the addition of some alum that the water cleared itself.

Dr. OWENS: With reference to Dr. Cornish's remarks, I recognized from the very start that the whole thing would be quite useless unless all errors were eliminated—at least, all errors which I could possibly think of—so I made every effort to eliminate them. I think Dr. Cornish's suggestion as to Table 3 is a very good one. I am very glad to hear that his own results support mine so far as they go. As to his question about sand—it settles in very sandy water more slowly than in water which is not so sandy. The sudden change in the behaviour of a current at a critical velocity of about 2·5 feet per second, with the formation of the curious waves referred to, is an extraordinary thing, and one which I have also observed. One thing I should like to say is this, that there is a sudden formation of a very densely filled layer of water in the bottom part of the stream, which is in contact with the ground, therefore that is the layer which is functioning as an erosive layer, being the part of the current in contact with the bed. I was very interested in Dr. Cornish's explanation of the position of particles falling through water. It certainly is an experimental fact. As to the discovery of the flat stones on the top of the ridge, that is, no doubt, due to their superior anchoring power, if I might put it so. In reply to Dr. Strahan's inquiry as to the specific gravity

of the sand being taken, what I did was this: in dealing with sand which was composed of mixed particles, I always timed a silicious particle, thus all the grains of sand which I have referred to in the tables are either quartz or flint, which is practically the same density.

REVIEWS.

EUROPE.

Phytogeography of Belgium.

'Esquisse de la Géographie botanique de la Belgique.' Par Jean Massart. Avec une annexe contenant 216 phototypies simples, 246 phototypies stéréoscopiques, 9 cartes et 2 diagrammes. Extrait du 'Recueil de l'Institut botanique Léo Errera,' Tome supplementaire VII. bis. Bruxelles: 1910.

The two volumes before us form a monograph on the vegetation of Belgium of the greatest interest to both botanist and geographer. It is most complete, and could well serve as a model for work in countries where the efforts of the different workers have not as yet been brought together in one book. It will not be long, we may hope, before a work on similar lines is published in our country. The author first gives an account of the past geology of the soil, and then discusses at length the various present-day conditions by which plants are surrounded and which influence plant-life. To these belong the climate and the soil. But the book is chiefly devoted to an analysis of the principal types of plant associations and an examination of the geobotanical districts. The former differ but little from those met with in the neighbouring countries. Though Belgium is not a large country, it can show all the types of vegetation except those of the highest hills and a few others. The climate is naturally more oceanic on the west coast, and becomes more continental towards the east. Subalpine plants are found on parts of the Ardennes. The near relation of Belgium to the neighbouring countries is well illustrated by the fact that of the higher plants, only one species, *Bromus arduennensis*, is found exclusively in Belgium. But much work has still to be done among the lower plants, the importance of which, from a geographical point of view, is not yet properly appreciated. Nearly all the plants found in Belgium to-day have come into the country since the last glacial epoch. There are only a few remnants of the glacial epoch now growing on the chalk in the highest portions of the country. The lowlying westerly districts have got their plants from the south-western regions of Europe, whilst the higher districts owe their flora mainly to central Europe. The first volume has at the end a Bibliography which contains a pleasing reference to numerous ecological books. The second volume is devoted entirely to photographs as illustrations of the first one. Many of these photographs are really very good, but many of them might have been left out. On the whole, however, the author must be congratulated on having produced a really valuable phytogeographical monograph.

O. V. D.

Northern Albania.

'Albanien und die Albanesen: Landschafts u. Charakterbilder.' By Paul Siebertz.

This book records some short journeys through the mountains of Northern Albania, but is chiefly valuable for the notes on the history, social customs, and character of the Albanians themselves, a very interesting people, one of the oldest of European races. The historical notes especially claim to be the fullest

since a publication by Hahn in 1853, and this would certainly appear to be correct. The photographs, showing the various types of the northern tribes, are excellent, and although no descriptive text is given for Southern Albania, some photographs of the people of that part of the country are included. Special attention may be directed to the photograph facing p. 224, which shows a robber band in Southern Albania. Three such types as are shown on the left of the picture would gladden the heart of any military commander in search of recruits. They certainly furnish strong evidence in support of the claim put forward by the Albanians, that they furnished the soldiers of Alexander of Macedon, who was himself a Southern Albanian. Their dress to-day would seem to have little changed since they followed their leader to the banks of the Indus. Although presenting somewhat the Austrian point of view, the book forms a useful study of the history and customs of this fine martial and gallant people, now entering the political limelight of the Balkans.

F. R. M.

'British Canals: Problems and Possibilities.' By J. E. Palmer. (London: Fisher Unwin. 1910. Pp. 254. 5*s*.) The late Mr. J. E. Palmer, who had experience of canal working probably under the most extreme economic difficulties—he was for many years a director of the Grand Canal of Ireland—was nevertheless a believer in the resuscitation of the British canal system. In the present volume he sets forth the lines on which he would proceed, accompanying his views with a criticism of those of other writers which are opposed to them. The book deals very largely with generalities, and technical descriptions are only introduced in certain instances where they are apposite to the argument. But the geographical relationship between some canals and the economic requirements of the districts they serve are clearly worked out.

'Great Britain and Ireland.' By Miss J. B. Reynolds. (London: Black. 1910. Pp. viii., 184. *Maps and Illustrations*. 1*s*. 4*d*.) This volume is designed for the upper classes of elementary schools and the lower and middle classes of secondary schools. It is almost severely simple in style, but on the other hand there are no dry bones which need clothing, and the text and clear diagrams together ought to prove suggestive to children ready to be interested. Such interest is fostered by numerous illustrations from photographs, which are generally (if not quite always) appropriate and well chosen.

'The Junior Scientific Geography.' Book I. 'The British Isles.' By Ellis W. Heaton. (London: Ralph, Holland. 1910. Pp. viii., 127. *Maps*. 1*s*.) This little book is clearly printed and well produced at the price. Its style is a product (if the expression may be allowed) of the tabular school; easy of reference and memory by pupils so long as they do not find it tedious. The maps are clear and helpful, but it is difficult to believe that in elementary schools the text (in some parts) would suffice by itself without something more than verbal explanation. Some passages read more like reminders of knowledge already acquired.

'The "Motor-Cycle" Route-Book of the British Isles.' (London: Iliffe. *N.d*. Pp. 176. *Maps*. 1*s*. 6*d*.) This little volume is well produced for its price. Nothing in the way of description of places or scenery is attempted, but each main road is followed by the chief points along it, each of which has the distance quoted for either direction of travelling. Hills and surface are referred to, and speed-limits are marked where existing. There is a full index. The maps (uncoloured), even though the distances between points are given, would have been improved by a scale, and the contours have been sadly lost in the printing.

'Recollections of an Old Mountaineer.' By W. Larden. (London: Arnold. 1910. Pp. xv., 320. *Illustrations.* 14*s.*) To justify and make attractive a volume of simple accounts of mountaineering holidays on well-known ground requires a certain individuality of style. This author possesses that qualification, and his book is pleasant to read, deeply appreciative of the natural beauties of Switzerland, and instructive in mountain lore, whether on snow or rock, in winter or summer.

'A Vagabond in the Caucasus.' By Stephen Graham. (London: Lane. 1911. Pp. vii., 311. *Illustrations.* 12*s.* 6*d.*) Not only the Caucasus, but Moscow and other parts of Russia find a place here. It is a book to dip into, taking an incident or sketch here and there; reading consecutively its chapters may leave a somewhat disjointed impression, and one may confess to scanty interest in the personal details. There is an appendix giving some little information for intending tourists.

'In the Rhône Country.' By Rose G. Kingsley. (London: Allen. 1910. Pp. x., 307. *Illustrations.* 10*s.* 6*d.*) This volume is well worth turning over for the sake of a very beautiful series of photographs. The text by itself would hardly justify the existence of the book. Private letters are a dangerous foundation on which to build a book; they must be beyond the ordinary as regards matter if they are to excuse even occasional grammatical lapses and the purely personal impressions which are so apt to leave the casual reader unmoved.

ASIA.

Persian Travels.

'Wanderungen in Persien.' Erlebtes und Erschautes von Hugo Grothe. Berlin: Allgem. Verein für Deutsche Literatur. 1910. 6*m.*

An unpretending descriptive record of travel in Western Persia. Dr. Grothe started from Baghdad eastward across the frontier and the Pusht-i-Kuh to Kerman-shah. After excursions to view the ruined sculptures of Tag-i-Bostan and the inscriptions of Bissutun, he proceeded to Hamadan, the "City of Gardens," and from thence to Tehran, the capital, where he had an audience of the Shah and paid a visit to a sitting of the Mejliss. The most important chapter treats of the general subject of Russian and British policy in Persia, in which full credit is given to the beneficial results of our telegraph lines and consular officials, our missions, hospitals and schools. There is, however, little that is new or striking in the author's comments and observations, though his personal adventures are now and then interesting. There is a fairly good collection of photographic illustrations.

Ptolemy's Geography of Eastern Asia.

Asiatic Society Monographs, No. 1. 'Researches in Ptolemy's Geography of Eastern-Asia (Further India and Indo-Malayan Archipelago).' By Colonel G. E. Gerini, M.R.A.S. Published in conjunction with the R.G.S. London: 1909.

The nucleus of this monograph is an article published in 1897 in the *Journal of the Royal Asiatic Society*, which has grown in the interval from 26 pages to close upon 1000, and embodies the work and devotion and thought of a lifetime. In fact, if the monograph had no other value, its value would be great as a model of constant and energetic pursuit of a purpose under difficulties and of vigilant and ingenious collection and appraising of odd scraps of evidence. This evidence is given in some 700 pages of the book, and will be almost appalling to the ordinary reader in the variety and unfamiliarity of the authorities placed under

contribution. Especially life-like and instructive in this respect is Colonel Gerini's treatment of the Golden Chersonese (pp. 77–81), both in its summary of the literary evidence and in its touch of personal experience.

The history of the investigations herein contained is briefly this. Colonel Gerini, who was for a long time stationed in the Further East, became interested in the ancient geography and history of the region, and soon discovered the importance of Ptolemy's work to that study, if it could be interpreted and made of use. He was, however, naturally dissatisfied with such previous efforts as had been made to accomplish this, considering them either too capricious—the identification of places rested often on a taking but quite superficial similarity of sound—or too unsympathetic, and therefore over-sceptical; there was little attempt to test Ptolemy's work from any point of view but that of a modern survey, and a wholesale rejection of it in consequence through sheer lack of critical sagacity. He was able, for very good reasons, to identify Ptolemy's Akadra and Pithonobaste with Hatien and Pantaimeas respectively, and he thus obtained means of comparing Ptolemy's longitudes and latitudes east of Kamberikhon (the centre of the delta of the Ganges) with ours. To give examples, the formulæ thus obtained place Aganagra at Hanoi, Solana at Hsi-ho (formerly Shang-lu), and Sera Metropolis at Lo-yang, the capital of China during the period of Ptolemy's activity; in each case, therefore, where the name or description of the place, as Ptolemy gives them, make it fitting that they should be. As formulæ worked more roughly in other cases, Colonel Gerini infers, what is in itself probable enough, that Akadra, Aganagra, etc., were base-points and were fixed by observation, while other less important places were fixed by rougher means, the time, for instance, which the journey took by land or sea.* In any case, however, the identification of a place rests on some system of calculation as well as on linguistic or historical probability, and herein Colonel Gerini differs from his predecessors; though his identifications may not always be right, and in fact he is not always convincing, one feels that they hang less in the air. Colonel Gerini's conclusions would, perhaps, be more convincing if he did not, as it were, think aloud and advance alternative explanations and etymologies, but the book gains in interest thereby, and probably also in completeness and in value; and the lack of arrangement, for which its author makes apology, is the natural penalty one has to pay for a fresh point of view and valuable pioneer work. His explanation of the turn which Ptolemy gives to the northern part of the east coast of China is ingenious and probable (p. 25).

We should add that the work, though dealing originally and chiefly with Eastern Asia, throws important light on the geography of Central Asia and on the history and commerce of both. It is, indeed, in the tracing of trade-routes (cf. p. 111 and Table XI.) and the rise and fall of dynasties and nations that much of the interest of a work consists, which leaves us also with a justly far higher estimate of the knowledge and enterprise and ability of the early centuries of our era than many of us know enough to concede.

H. S. C.

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* We may note the difference in the formula for latitudes north and south of Cape Temala—the nearer the equator, the harder observations were to take. We must remember, also, that Ptolemy's map was on a very small scale, and that he fixed the position of places by twelfths of degrees.

TIBET.

'India and Tibet.' History of the relations between the two countries. By Sir Francis Younghusband, K.C.I.E. London: Murray. 1910. 21*s. net.*

No better authority than Sir Francis Younghusband could have been found to write a record of the Tibetan expedition of 1903–04 and the events that led up to it. And the story of the expedition practically occupies the whole of this work for the events from the time of Warren Hastings' mission in 1774 up to Lord Curzon's attempts in 1899 to open direct communication with the Tibetans only cover sixty-five pages. It will be understood, therefore, that the present book is historical and political rather than geographical; at the same time geography plays such an important part in the better understanding of the Tibetan problem that we should have liked rather more detailed information regarding the trade routes of the country, particularly those leading into India and the passes across the Himalayas, and the practicability of the routes through Bhutan and the Mishmi country, which are at present very imperfectly known. The author's principal suggestion towards remedying the anomalies and difficulties of the present *impasse* is the appointment of a British agent at Lhasa, and on the whole one is forced to agree with him. But at the same time the chief justification of such a step would be found in the expectation of a lucrative trade being thereby fostered, for this is, after all, the mainspring and general object of ordinary international intercourse, to which hitherto our governments have been so strangely opposed in the case of Tibet. A carefully written chapter on the existing resources of Tibet, and the opportunities for trade would thus have been most welcome, for the subject is extremely important and little understood, though ample materials for a trustworthy account are available in every direction. The present state of the relations between India and Tibet is clearly temporary. With the advent of the Chinese at Lhasa a radical change in the political and social organization of Tibet must occur sooner or later, and the monkish supremacy must give way in the end. Neither the Tibetan people nor their Chinese masters are opposed to commercial dealings with their neighbours, so we may fairly anticipate that the new *régime* will be productive of a better *entente* between India and her northern neighbours.

'Forest Life and Sport in India.' By S. Eardley-Wilmot. (London: Arnold. 1910. Pp. xi., 324. *Illustrations.* 12*s.* 6*d.*) This we should judge to be an important work on its subject. It is written by an ex-inspector-general of Indian forests, who in his book has made sport only incidental to his work, as it was in actuality. Without entering into technicalities, the book covers the whole subject of forests in the Indian Empire, describes and illustrates them and their diverse conditions, clearly shows the present position of forestry as a branch of the administration, and gives indications of the duties of a forester.

AFRICA.

GERMAN EQUATORIAL AFRICA.

'Zwanzig Jahre in Deutschen Kolonien.' By Major Wilhem Langheld. Berlin: Wilhelm Weicher. 1909. 10*m.*

In October, 1889, Major, then Lieutenant, Langheld joined von Wissmann's staff at Dar-es-Salaam, where he met Stanley and Emin Pasha on their return from "darkest Africa." A little later he met the ill-fated trader Stokes. His African services, which thus link on to the romantic era of exploration, did not end until February, 1908. From 1889 to 1900 he was employed in German East

Africa, and visited practically every district of that protectorate. In 1900 he was transferred to the Cameroons, where he became Resident in Adamawa and (German) Bornu. Thus he had exceptional means of becoming acquainted with large areas of equatorial Africa, playing during twenty years a worthy part in the upbuilding of the German colonial empire. His book shows him to be a capable, observant, and sympathetic official. He has not attempted to write a monograph on either of the colonies with which he was connected, but he gives in a simple straightforward style a very readable account of his experiences, whether in leading expeditions or engaged in the work of administration. His early chapters contain interesting information concerning Emin's last expedition, and we have later the story of the founding of German stations on the shores of Victoria Nyanza. The book is perhaps most useful as exhibiting the growth of German colonial experience. One chapter gives some account of Togo, where the author spent some months in 1907. There are numerous illustrations, of varying merit, and sketch-maps (showing administrative divisions) of German East Africa and the Cameroons on the scale of 1 : 5,000,000.

F. R. C.

South Africa.

'History and Ethnography of South Africa, 1505 to 1795.' By G. McCall Theal. 3 vols., with Maps and Plates. London: Swan, Sonnenschein. 1908–10. *7s. 6d. each volume.*

Reference has been more than once made to the irregular appearance of Dr. Theal's various works on South Africa. It is pleasant to be able now to add that much of the resultant confusion has been removed by the "re-arrangement" of the whole series completed by the author in 1910. In this new and complete issue, the somewhat scattered volumes—eight altogether—are clearly grouped in two comprehensive sections, comprising three and five volumes respectively. The second section consists of the five volumes amply noticed in the *Journal* for September, 1910, while the first section of three volumes is made up of the volume reviewed in vol. 31 of the *Journal* and the two volumes now to be considered.

It will be remembered that the just-mentioned vol. 1 of this section was chiefly concerned with the aborigines—Bushmen, Hottentots, and Bantus—and with the first voyages of the Portuguese, Dutch, and English round the Cape (chaps. i. to xx.). Vol. 2 (chaps. xxi. to xliii.) deals exclusively with the foundation and early history of the Cape Colony by the Dutch, covering the period from April, 1652, to February, 1751. Detailed accounts are given of Jan van Riebeek, first commander, and of his nine successors to Simon van der Stel, raised to the rank of governor in 1691. Then follows a very complete survey of the administration of Van der Stel's ten successors to H. Swellengrebel, bringing the history of the Colony down to the year 1751, and completing vol. 2. Here we have full particulars of the early Dutch settlers, and of the later French (Huguenot) arrivals, with their mutual relations and joint attitude towards the Hottentots, Bushmen, and other aborigines. Ample space is also given to the temporary occupation of Delagoa bay, and to the various landward expeditions, by which the area of the Colony was gradually extended northwards to the Orange river.

In vol. 3 (chaps. xliv. to lix.), the account of the Dutch rule is continued from 1750 (retirement of Swellengrebel) to the British occupation (1795). A graphic picture is given of the condition of the European colonists at the close of the Dutch *régime*, and special chapters are devoted to the events in Portuguese South Africa and to the Bechuanas and other natives during the eighteenth century. Valuable for reference purposes is a copious statement of the MSS. and printed

works in the Cape and Dutch archives relating to South Africa during the period from 1505 to 1795. Equally serviceable is a very full *Synoptical Index* (pp. 407–499), giving a summary of the contents of all three volumes and imparting complete unity to the whole series.

Useful historical maps are those of South Africa in the seventeenth century and of Cape Colony in 1700, 1750, and 1795.

A. H. Keane.

A Vade Mecum for West Africa.

'The Niger and the West Sudan; or, the West African's Note Book.' By Captain A. J. N. Tremearne, D.Anth. (Camb.), etc. London: Hodder & Stoughton. 1910. 6*s. net.*

Captain Tremearne's useful manual is divided into four parts. The first is historical and statistical, and bears strong testimony to the author's industry in collecting his information. Part II. is of more importance. In it the races of British West Africa are discussed—the Fula, the Hausa, the Yoruba, and others. On this subject the author has not only collected the views of others; he has made original investigations. For instance, he has obtained a new tradition concerning the origin of the Fula (see p. 38: the book must be read with attention to discover what in this section is new). His conclusions concerning the Fula seem sound, but the evidence on which he assigns "ancient Ethiopia" as the first home of the Hausa does not appear convincing. This division of the book ends with an essay on proper and improper lines of development of African races, and on such a subject the views of an officer who has had much experience of natives and is conversant with their modes of thought deserve careful consideration. Part III., "Hints and Suggestions," contains a great deal of valuable information, and should be studied carefully by every one who intends visiting West Africa. Captain Tremearne writes with the knowledge gained by ten years spent on the West Coast, and his hints are very much to the point. The Hausa phrases may be specially instanced for their usefulness to beginners. On such matters as travelling, food and drink, health and recreation, the author's advice is eminently sensible. Part IV. consists of appendices, in which are given lists of appointments together with the salaries attached, kit lists (with prices), etc. Probably the kits of most men who hereafter go to the West Coast will include a copy of this book.

'Uganda for a Holiday.' By Sir Frederick Treves. (London: Smith Elder. 1910. Pp. xi., 233. *Maps and Illustrations.* 9*s.*) Even on the outward journey of the Marseilles express the writer finds material for vivid, even lurid writing. The book does not give the impression of a very enjoyable holiday, but it contains a good deal of varied information, notably on such topics as might be expected to interest the author especially, such as native life and the sleeping-sickness. But he has also a keen eye for scenery, and his descriptive powers are not untinged with humour. Displaying as he does a knowledge of the country, not merely superficial but studied, it is a pity that he could not prevent the use of a map which, in spite of the imposition of a railway and a new frontier, bears several evidences of antiquity.

'Letters and Sketches from Northern Nigeria.' By Martin S. Kisch (London: Chatto & Windus. 1910. Pp. xii., 232. *Maps and Illustrations.* 6*s.*) It may or may not be unusual for colonial officials to put so much careful and detailed observation into their ordinary correspondence as did this assistant

resident, who died after only a short term of service of great promise. At any rate, it is seldom that the public has the chance to learn something of such work from within, and we may therefore be grateful for these colloquial, humorous letters, often illustrated with sketches of the roughest, but full of life.

AMERICA.

'Farthest West.' By C. R. Enock. (London: Longmans. 1910. Pp. 328. *Maps and Illustrations.* 15*s.*) This study of the American people deals largely with those of their characteristics which would first impress themselves on the casual traveller, though much of the information in the book shows the author's wide experience of the country. These character-studies of modern civilized peoples necessarily contain much that is matter of opinion; at any rate on geographical matters, such as regional studies, scenery, lines of communication, Mr. Enock's work may be read with profit.

'The Channel Islands of California.' By C. F. Holder. (London: Hodder & Stoughton. 1910. Pp. xvi., 397. *Maps and Illustrations.* 7*s.* 6*d.*) The author is known as a writer on angling topics, and the angler's interests are paramount in the present volume. But it has the additional interest that the author was a pioneer in introducing these islands to the public as sporting resorts. He knew Santa Catalina island when the holiday-town of Avalon did not exist; he has an intimate knowledge of the remarkable physical character of the islands and surrounding seas, and he has studied the remains left by the natives in the ages before the first Europeans arrived in the locality.

'Our Search for a Wilderness.' By Mary Beebe and C. W. Beebe. (London: Constable. 1910. Pp. xx., 408. *Map and Illustrations.* 10*s.* 6*d.*) The object of the two journeys described here, to Venezuela and to British Guiana, was ornithological, and not only in the text but in an appendix the scientific results are set out. But the text is mainly narrative, and the second part is of particular interest as the travellers touched virgin territory in British Guiana, and they have a good power of description and supply some fine photographs. A further work on the natural history of the region is promised.

'Cecil Rhodes: his private life.' By P. Jourdan. (London: Lane. 1911. Pp. 287. *Illustrations.* 7*s.* 6*d.*) The writer was Rhodes' private secretary. When the possible pitfalls threatening a work of this kind are considered—those of political controversy on the one hand and those of the Boswell-Johnsonian style on the other—there is no course but to compliment the writer heartily on avoiding them. The book deals with many living men and women, often in an intimate manner; here Mr. Jourdan handles his subject delicately. There is a special interest to geographers and a lesson to others in this sentence (the context dealing with Rhodes' imperial interests)—"Maps had a fascination for him, and he was always studying them."

AUSTRALASIA AND PACIFIC ISLANDS.

Islands of the Southern Seas.

'The Subantarctic Islands of New Zealand. Reports on the Geo-Physics, Geology, Zoology, and Botany.' Edited by Prof. C. Chilton, M.A., D.SC. Two volumes. Pp. xxxv. + 848. *Plates, Photographs, Figures, and a Map.* Philosophical Institute of Canterbury, New Zealand. London: Dulau. 1909. *Price* £2 2*s. net.*

These two volumes contain the results of a brief visit made by several New Zealand scientists to the Auckland and Campbell islands, in November, 1907. Advantage was taken of the annual trip of the Government steamer *Hinemoa*

on her search for possible castaway sailors on these and other islands. The Government not only gave passages to the party, but voted a substantial sum towards the expenses and the cost of publication of the results. Eight days were spent by a party of twelve on Campbell island, and about twelve days on the Auckland islands by a party of ten, among whom was Dr. C. Chilton, the editor of the reports. The amount of work done was considerable, especially when the hurried nature of the expedition is considered. An historical introduction supplies a missing chapter in the history of southern exploration. Among the various zoological monographs are papers by Mr. E. R. Waite on the Mollusca, Mr. G. V. Hudson on the entomology, Prof. G. H. Carpenter on the Collembola, Dr. Chilton on the Crustacea, Prof. W. B. Benham on the Chætopoda and Echinoderms, and Prof. A. Dendy on the Holothurians and Planarians. A disappointing report is that on the birds, for the avifauna of these islands is imperfectly known.

The most complete chapters are those on the systematic and ecological botany. In this case there was some previous knowledge to assist the authors, and the expedition had the great advantage of being accompanied by Dr. L. Cockayne, who is responsible for the report on the ecological botany of the Aucklands, including some remarks on that of the Antipodes, Macquarie island, and the Snares. Mr. A. M. Laing contributes a similar chapter on Campbell island. Mr. T. F. Cheeseman writes a general account of our knowledge of the systematic botany of all these islands, and discusses the flora at some length from a distributional point of view. Dr. Chilton summarizes the results of the expedition, especially as regards the biological relations of the subantarctic islands.

The primary object of the expedition was the extension of the magnetic survey of New Zealand. This has now been done for the Auckland and Campbell islands, but no observations have been taken on the Antipodes, Bounty, and Macquarie islands. The geology of the Auckland and Campbell islands has been investigated, and something is known of the Antipodes and Bounty islands, and, thanks to the *Discovery*, we know that Macquarie island is built largely of basalts and dolerites. The *Nimrod* made collections at Macquarie island last year, but these have still to be published. The *Nimrod's* soundings in these seas should also be of importance. But we have no satisfactory series of soundings between Macquarie island and the Aucklands and Campbell island. It is gratifying to hear that instructions have been given to H.M. ships to take soundings in these waters whenever they visit these seas and islands. Particularly desirable also would be an exhaustive biological study not only of Macquarie island, but also of the Balleny islands in relation to the former connection of Victoria Land with Australia and New Zealand. All these southern islands, in fact, would repay further and more thorough investigation, and can we not look to New Zealand and Australia to follow the example of the Argentine Republic and institute permanent meteorological observatories on some of their subantarctic islands?

The occurrence of plutonic rocks in the Snares, Auckland, Bounty, and Campbell islands point to former continental connections, and the soundings between these islands and New Zealand bear out this contention. Macquarie island, as far as we know, is volcanic, and is certainly surrounded by much deeper water than the other islands. The biological evidence seems all in favour of the former land connection, but as to the date, there remains considerable uncertainty. Dr. Chilton would fix the period of the greatest northward extension of Antarctica as late as Eocene times, which is a date considerably more recent than that assigned by most authorities.

A large folded map of antarctic and subantarctic regions accompanies the

volumes. The bathymetry of the southern seas is shown, and the distribution of known land in Antarctica. We notice, however, that the names Danco Land (misspelt Dango) and King Oscar Land should be interchanged, the latter being on the east, not west, of Graham Land as shown. Magnetic observatories are marked on this map; but there is no indication of one on South Georgia where we believe the Argentines recently took a series of magnetic observations during a stay of several days. The volumes are copiously illustrated.

R. N. R. B.

'The Log of H.M.S. *Encounter*.' By H. M. Fowler. (London: Westminster Press. 1910. Pp. iv., 129. *Illustrations*.) This is not, as might be expected, a record of the navy in earlier days, but the story of a ship of the navy of to-day, whose crew, for two years from 1908, were in service on the Australian station. The story is very simply told in diary form, and sets before the non-technical reader a picture of the routine duties of the crew, their adventures, their amusements—on two occasions their disasters. Such is the object of the series to which the book belongs, which is called the 'Log Series.' The book may also be read with profit from the point of view of the descriptions of the New Zealand and other coasts visited.

'Australia: the Making of a Nation.' By John Foster Fraser. (London: Cassell. 1910. Pp. xix., 299. *Illustrations*. 6*s*.) Mr. Fraser has through previous works the standing of a sort of apostle to new nations, and in the present volume he studies the Australians as he found them, and offers them his views as to their character and future. He deals at length with the standard industries, labour problems, government, and education. The book is not confined to the settled parts of the island-continent; there is a chapter, for example, on the physical conditions and potentialities (the word is borrowed from Mr. Fraser, and by him from the Australians) of the difficult and scarcely exploited Northern Territory.

'Through Tropic Seas.' By Frank Burnett. (London: Griffiths. 1910. Pp. xvi., 173. *Illustrations*.) A pleasant record of life among the Pacific islands —Hawaii, Tongareva, Manihiki, Christmas and Fanning, the Gilberts, Fiji, etc. —by an author who is able to bring to bear on the subject a longer experience than that of the casual voyager. The natives (of whom there are many illustrations), the natural products and characteristics of the islands, their history, and even the fascinating, inaccessible question of their archæological remains, are dealt with at length, if somewhat at hazard, and only so far as each subject came under the writer's notice during his wanderings.

POLAR REGIONS.

The North Pole.

'The North Pole.' By R. E. Peary. London: Hodder & Stoughton. 1910. Pp. xii., 315. *Map and Illustrations*.

"My dream and goal for twenty years. . . . It seems all so simple and commonplace." These words, which Commander Peary quotes from his diary, written, not, indeed, at the moment of his victory, but on waking after his first few hours at the North Pole had been spent in necessary sleep, provide a sort of text for the whole of his book. Commonplace, in truth, it cannot be in the minds of his readers, but simplicity is the keynote of the whole work—of style in the narrative, and of purpose in the expedition itself. Along with this, any reader of Arctic literature will realize a sense of having read the whole story before,

with just the difference in tone afforded by success. For the traveller has on this occasion to tell of no startling or unforeseen adventures; his story is merely one of the usual struggle against normal Arctic conditions, waged by him and his little army as perfectly equipped as his experience could make them, and furthered to its objective by the best of fortune, save for a single tragic incident.

From the point of view of "taste" (if that be not too presumptuous a term) it may be said at once that the book could hardly be better written. There are intimate personal touches, as at the leave-taking and at the sending of the first home messages of success; there are words of personal satisfaction at that success; but there is never too much of them. There are constant and unstinted acknowledgments of the splendid support afforded by the explorer's subordinates; he can hardly refer to Ross Marvin without some word which shows the depth of his regret at the disaster which robbed him of his keen and gifted assistant. From that sad mishap may be inferred something of the good fortune which attended the rest of the party. Of this we are reminded again by such words as these—"A lead might have opened right through our camp, or through one of the snow igloos, when we were sleeping on the surface of the polar sea. Only—it didn't." This possibility is made the text for a sermon against the use of the sleeping-bag on the sea-ice; indeed, on the whole question of organization, future travellers will find this a profitable text-book.

The world shares a measure of Peary's luck, for, with or without it, we learn that he would not have made another attempt. Efforts to be second at the Pole will hardly seem worth the making. Peary has probably saved the lives of people who might otherwise have trusted to inexperience or airships to carry them there, and future Arctic expeditions will not include "a dash for the Pole" as part of the programme. It must be left to the instinct of the individual reader whether he be satisfied with this as the greatest possible achievement in Polar travel, or will set more store by the discovery or disproof of new lands in the unknown quadrant, or the clearing up of other scientific problems.

Peary was out to reach a point, and science had to take the best place it could find in his arrangements to that end. His deep-sea soundings illustrate this. He took two reels, each carrying a thousand fathoms of piano-wire, and three leads. The whole weighed 103 lbs., "and so far as I know, they were the lightest, for their capacity, that have ever been used." This feature, essential in the circumstances, presumably accounts for the breakages which necessitated the use of pick-axes for a lead on one occasion, and rendered the deeper soundings (including that close to the Pole) indeterminate. Five sea miles from the Pole there was no bottom at 1500 fathoms. The edge of the continental shelf was found about 83° 53′ N.; at 84° 29′, 828 fathoms were sounded, but at 85° 23′ there were only 310 fathoms (the map, by the way, is in error at this point). At the three soundings thereafter there was no bottom at 700, 1260, and 1500 respectively, and that is the extent of the work. So far as it goes, it bears out the theory of the polar basin developed from Nansen's soundings.

But the noteworthy shallow sounding at 85° 23′ is adduced as bearing upon the question of the supposed existence of land north of Beaufort sea, on which (*inter alia*) Mr. R. A. Harris of the U.S. Coast and Geodetic Survey contributes an appendix. Tidal observations were carried out under instructions from this department; they were made on the coast, and they and the ice-journey did not interfere one with another. A bulletin on these observations is promised by the department, but one of their most important results is stated to be the proof

that the tide at Cape Columbia comes from the west. "It is the Baffin bay tide transmitted, first north-westerly through the eastern portion of the Arctic archipelago to the Arctic ocean, and then easterly along the northern coast of Grant Land to Cape Columbia. That the tide wave should be felt after a passage of this kind instead of practically disappearing after entering the Arctic ocean, is one argument for the existence of a waterway of limited width to the north-west of Grant Land." This, and the arguments already known to students of the problem (and outlined by Sir C. R. Markham in the *Journal* of January, 1906), are adduced to indicate "an obstruction (land, islands or shoals) containing nearly half a million square miles," and demarcated roughly by points adjacent to Bennett island, Point Barrow, Banks Land, and Peary's Crocker Land. This would suggest that Mikkelsen's sounding of no bottom at 339 fathoms about 72° N., 150° W. indicated something in the nature of a deep Mediterranean basin, and probably not all authorities will follow Mr. Harris so far on the evidence; does it justify the assumption of anything beyond comparatively small land-masses towards the east and west extremities of the area indicated?

Meteorological observations were taken, of course, and are compared with those of Greely at Fort Conger, with which they "agree well." In an allied scientific connection, a student of the geography of diseases may find interest in the comments on the evidence of "grippe," which is said to be coincident in the Arctic with epidemics at home. An attack experienced by Peary in 1892 followed a storm from the south-east, "more than a local disturbance," which raised the temperature over 70° in a day.

Illustrations are copious and, on the whole, "worthy of the occasion," though the difficulties attendant on photography during a "drive" over the ice (to use the traveller's own term) are sometimes apparent. A notable feature is the reproduction in facsimile of some of the observations as to position. Perhaps the reader may be allowed a smile at the convenient ice-mound which is honoured as representing the pole.

O. J. R. H.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

The Altitudinal Limits of Vegetation in the Mediterranean Area.

'Beiträge zur Kenntnis der Hoehengrenzen der Vegetation im Mittelmeergebiete.' Von Dr. Max. Koch. Halle-a-S.: C. A. Kaemmerer & Co. 1910.

This book is an attempt to interpret, analyze, and explain the relations existing between the numerous meteorological and botanical observations made in the Mediterranean area. After a few historical notes, the area under discussion is mapped out, and its limits are defined according to its geology, its climate, and its flora. After a careful consideration of the material at his disposal, the author has come to the conclusion that the height to which certain types of plants ascend in the Mediterranean area is dependent on certain isothermal lines. The altitude to which the Mediterranean vegetation generally ascends is dependent on the course of the 5° January isotherm as reduced to sea-level. The altitude to which trees ascend in the Mediterranean area is dependent on the course pursued by the 10° July isotherm, again reduced to sea-level. In each case a rise to a higher altitude of the isotherm induces an ascent of the particular form of vegetation. The purely Mediterranean plants are most under the influence of the January and the central European plants are most under that of the July isotherm. From the point of view under consideration, the rainfall does not to any great extent seem

to affect the vegetation, except in the case of the forest formations. The author has worked through a large amount of material in the course of his studies, and his complaint is that it is not yet complete enough, but he hopes that this contribution to the subject may lead to the existing gaps being filled up in time.

O. V. D.

A Text-book of Meteorology.

'Descriptive Meteorology.' By Willis L. Moore, LL.D., Sc.D. *Charts and Illustrations.* New York and London: D. Appleton & Co. 1910. 12*s.* 6*d. net.*

This is a comprehensive and clearly written treatise on the principles of meteorology, designed to meet the requirements of all students of the subject, but especially of those entering the service of the United States Weather Bureau. With the rapid growth of meteorological science, many of the better books are getting out of date, and Dr. Moore's text-book, thoroughly brought up to date, should be of great use to English readers. Some of the "knotty" problems in meteorology are elucidated in a clear and concise manner, such as we miss in most other books. We have, for instance, searched through many treatises for a satisfactory explanation of the cold on mountain-tops, but most authors make no reference at all to the causes of this striking and all-important fact of physical geography. Dr. Moore, in one short paragraph, says, "The absorption of solar and terrestrial radiation by the air is greater in its lower levels where dust, water-vapour, and cloud are densest, while the transmission of both incoming and outgoing radiation is more rapid through the purer air aloft. Thus we account for the coolness of all mountain peaks, and the perpetual freezing temperature of some, even though they be located in the tropics, and though their tops occupy positions several miles nearer the sun than the bases from which they rise." This does seem to get at the gist of the matter. Mountain peaks are cold, not so much because the atmosphere over them is thin and cannot act as an efficient blanket in preventing the escape of the sun's heat, as because they rise isolated into the cold upper levels of the atmosphere where the air is too rare, pure, and dry to absorb the solar radiation which passes through it and to thereby become heated. Dr. Moore devotes some attention to the theory of rotary storms, and the possibility of including atmospheric eddies in certain well-known simple types of vortex motion, like the dumbbell shaped or funnel shaped. But quite the most interesting point we learn in connection with cyclonic movement is the apparent fact that storm systems are translated *en masse* in the general drift of the atmosphere, and not merely propagated as a sort of wave disturbance, as has sometimes been suggested, always affecting fresh masses of air. Thus the prevailing westerly surface winds or anti-trades of the north temperate zone are constantly being broken up into passing cyclonic or anti-cyclonic eddies which obliterate the general eastward drift of the atmosphere, but when the winds of these rotating systems, depicted on isobaric charts, are resolved into their components, and the cyclonic components subtracted, a persistent current from the west remains. This is a hydrodynamic question of great importance, and we are glad to welcome information respecting it derived from solid facts. We do not much care for the somewhat elaborate system of classifying climates which Dr. Moore has quoted from various meteorologists, and indeed always hold that after a broad classification of climates into hot, warm-temperate, cool-temperate, and cold, on the one hand, and into equable, or extreme, on the other, the climate of any particular region on the Earth's surface had better be *described* on its own individual merits, and not entered into any detailed scheme of classification, since the subject does not lend itself to classification, one climate merging imperceptibly into another.

The work is handsomely illustrated with photographs, weather-charts, etc.,

and is dedicated to the pioneers of American meteorology. It is altogether an admirable book.

L. C. W. B.

GENERAL.

'A History of the British Dominions beyond the Seas.' Edited by A. H. Forbes. (London: Ralph, Holland. 1910. Pp. 239. *Maps.* 2*s.* 6*d.*) This, with the necessary copious additions and amendments up to the present date, is a reissue of Clough's 'Expansion of the British Empire (1558–1858).' It begins with a survey of the reasons for and processes of colonization, provides a chapter on the early navigators, and then deals successively with the history of British rule in India, America, the West Indies, Australasia, and Africa, and with miscellaneous acquisitions. Over some of these last it would seem to pass too lightly—Malta, for example, and the oceanic islands of the Pacific. In arrangement it is good, as a book of reference; there are copious chronological tables, and the short glossary of colonial terms is a feature of some value, but the index omits some necessary references. The sketch-maps are well chosen, but suffer from somewhat indifferent printing.

'Manual of Languages.' By Captain C. Slack. (London: Simpkin, Marshall. 1910. Pp. 128. *Maps.* 3*s.* 6*d.*) This volume, containing words and phrases in twenty-three languages, makes a wide appeal, which may be judged to have been answered from the appearance of this, the seventh edition. Not only are the general requirements of tourists catered for, but also those of certain special classes, such as motorists, who might, however, welcome the addition of a few more technical terms for parts of their machines. And as the tourist has few occasions for the use of such languages as Latin or Welsh, the book is clearly designed for use outside this body. The price of the volume is small in comparison with the labour of its compilation, and an unusual feature in such works is provided by the maps of Europe and Asia.

THE MONTHLY RECORD.

EUROPE.

A Record of Ancient Fortifications in England.—At the Congress of Archæological Societies held in London in 1901, a committee was appointed to prepare a scheme for the systematic record of ancient defensive earthworks and fortified enclosures in this country, it being felt that such a record, in the form of lists drawn up by local workers, would be of value in connection with any efforts for the preservation of those antiquities. The committee (whose hon. secretary is Mr. A. G. Chater, 41, Porchester Square, W.) has lately issued a revised edition of its recommendations to this end, including suggestions for a uniform system of classification to be adopted by workers (with specimen plans of actual antiquities of each class), and also general hints on the preparation of plans and schedules. It is suggested that a definite area should be undertaken by each worker, and that his operations should be carried out with the aid of the 25-inch Ordinance Survey map of the district, or the largest-scale map available. Tracings should be made from the published maps, and any omission in these made good by independent surveys. To facilitate comparison, it is desirable that all plans should be drawn, if possible, on the 25-inch scale. Full

details of the information to be supplied, and the manner of representing the form of ground and the antiquities, are given in the paper.

River-levelling in France.—In an article published in the *Annales de Géographie* for July 15 last, M. de Margérie has given a useful *résumé* of the progress so far achieved in the precise determination of the longitudinal profiles of French river-courses. The article begins with a short historical summary of the subject, showing that the first attempt in the direction of the precise measurement of the slope of rivers was due to the engineer Krayenhoff, who published a profile of the Leck and lower Meuse in 1813. The subject has, however, been but imperfectly studied by geographers, and it is remarkable that in a work like Reclus's Universal Geography, in which so much attention is devoted to the work of running waters, river profiles are almost entirely wanting. The material at present existing consists either of detailed large-scale profiles, prepared chiefly for technical purposes (navigation, etc.), of which excellent examples are supplied by the profile of the Theiss, published by the Hungarian Ministry of Agriculture, and the series relating to the basin of the Rhine, published by the Swiss Public Works department; or of generalized synoptical views of a whole system, such as have been issued by the Prussian Government in the case of the chief German rivers. In France a considerable amount of field work has been carried out in this department, though it is not all generally available, and there is no one work presenting a general view of the available statistics. M. de Margérie gives a map of the French waterways which is valuable as showing at a glance the present state of research in regard to river-slopes, and the varying degrees in which the results have been made available. It distinguishes (1) watercourses of which profiles have been published in France; (2) those of which profiles have been published abroad; (3) those in regard to which profiles exist only in manuscript; and (4) profiles lately determined by the Nivellement Général de la France by arrangement with the ministry of agriculture. The results hitherto published in France (chiefly by the Ponts et Chaussées Department) have to do almost solely with the basins of the Seine and Loire, but while in the case of the Loire the published information both with regard to the main stream and its tributaries is very complete, in the case of the Seine it is limited to the navigable portion of the main stream and the lower Yonne. In the case of the Garonne, although unpublished material is abundant, none has yet been made available, with the exception of a synoptical profile annexed to an autograph report of the Inspecteur des Ponts et Chaussées. On the side of the Mediterranean, with the exception of a small-scale profile of the Ardèche, nothing at all has been published by the Ponts et Chaussées Department. In the extreme north-east, strange to say, all the published material is due to foreign enterprise, profiles of the systems of the Meuse and Moselle having been published in Belgium and Germany. A new demand for precise information on the fall of rivers has lately arisen in connection with water-power utilization, for which a knowledge of the upper basins of rivers, hitherto neglected as unnavigable, is particularly needed. It is from this point of view that a survey of the rivers of the French Alps has lately been undertaken by the *Nivellement Général* under M. Lallemand. A considerable amount of work has been done, some account of which will be found in the November number of *La Géographie*, as well as in M. de Margérie's paper.

The Trade of Genoa.—In the recently issued Consular Report on the trade of Genoa and district for 1909, there are some remarks by Mr. Consul-General Keene on the question of congestion of traffic in the port referred to by Prof. Guibaudi in the paper noticed in the November number. The congestion complained of in 1909 was mainly due to lack of railway waggons, which

is not an unusual thing after the vintage season, but there were also other reasons in that year, such as the moving of troops all over the country and an unusually large influx of vessels. Besides others, British vessels crowded the port, chiefly with cargoes of coal, and on most days in those months there were not fewer than 40 ships' papers in the Consulate. Considering there are but 29 coal discharging berths, it is scarcely surprising that there should have been a congestion. In spite of an increase of 198 British steamships entering the port with an increase of 350,058 in tonnage, the general trade of Genoa, which was on the increase up to 1906, has since decreased. There are openings in the district for British trade, especially in regard to cutlery, which, as a matter of fact, was mostly supplied by Sheffield down to about 20 years ago, when the trade therein was captured almost entirely by German, French and Austro-Hungarian manufacturers, the reason being the usual one of lower prices and goods offered freight and duty free. Mr. Keene considers, however, that British manufacturers have still a good chance of recapturing the Italian trade, if they carefully study the kind of articles required and offer them freight and duty free by means of travellers and agents.

ASIA.

Teram Kangri.—Dr. T. G. Longstaff sends the following note: "Through the kindness of Mr. Sella and Dr. de Filippi, I have recently had the opportunity of examining a photograph taken by the former on June 22, 1909, from about 20,100 feet near the Sella pass shown on the Duke of the Abruzzi's map. The distant ranges to the south-east are dominated, as noted by Dr. de Filippi in his paper read before the Royal Geographical Society on November 21 last, by a very lofty snow-peak. If this be compared with my photographs of Teram Kangri taken from the south, a marked resemblance will be observed in the form and relationship of the peaks seen in both, and I think it can be shown fairly conclusively that the two mountains are identical. These photographs, including that kindly presented by Mr. Sella, are in the Map Room collection. Though Mr. Sella was, of course, quite ignorant of the fact that, by a curious coincidence, this peak had been observed from the south a few days earlier, he obviously suspected its importance, for he recorded an angle of 121° E. by prismatic compass. If we take magnetic variation to be 5° E., the true bearing is 116°. If my location of Teram Kangri be accepted as correct, the true bearing should have been 117°, a remarkably close agreement. Mr. Sella's point of observation is at an angle of 90° with my own. The true horizontal mid-line in the print has been deduced from the known positions and altitudes of Gusherbrum II. and III., and of Hidden peak, all of which appear in the photograph. The focal length of the camera is 12 inches, and again assuming my location of Teram Kangri to be correct, and its distance to be therefore 34½ miles, as nearly as can be measured, the highest point in the photograph works out at just over 27,000 feet. This is a good approximation, when the numerous possible sources of error involved in such a method are taken into account, with the 27,610 feet with which I credited the peak. The above calculations have been worked out with the greatest possible care under the direction of Mr. Reeves."

Kumdan Glaciers.—We have also received the following from Dr. Longstaff: "Captain D. G. Oliver writes from Leh (July 28, 1910) that 'the Aktash (glacier) has advanced over that rock at the snout from which we took photographs last year' (see *Geographical Journal*, vol. 35, p. 650: one of the photographs referred to is in the Map Room collection). On his return from Yarkand, Captain Oliver also visited the ill-defined water-parting near the

south foot of the Karakoram pass, to which I alluded in the *Geographical Journal* (vol. 35, p. 653). He writes, 'Crossing the Karakoram, I went as far as that water-parting which we saw on the west side of the pass; . . . it (the stream or valley) looks as if it turns north-east at the furthest point you can see, in which case that water-parting must be a col on the main Mustagh range.' "

Dr. Zugmayer's Expedition to Baluchistan.—Dr. Erich Zugmayer, the young Austrian zoologist whose journey in Tibet a few years ago was referred to in the *Journal*, sends us some details as to his plans for an expedition of zoological and other research in Baluchistan. He hopes to sail from Trieste in January, and to arrive at Karachi early in February, travelling up thence to Quetta to meet Sir H. McMahon, who has kindly offered his assistance. After preliminary work in Sinde, the explorer will finally start with a caravan early in March, and, stopping *en route* at points good for collecting, hopes to reach Gwadar in May. The hottest part of the year will probably be spent in the uplands, Kelat being reached in September, and the return journey commenced thence, the whole expedition being completed before the end of the year. Besides zoological work, the traveller hopes to collect plants and fossils, and to construct a rough geological profile of the country traversed.

AFRICA.

Austrian Expedition to the Sahara.—Further information as to this proposed expedition has been received from Vienna, both correcting to some extent and supplementing that supplied in the December number. It seems that Herr Artbauer had not proceeded to Tripoli in October, as had been supposed, some delay having occurred owing to difficulties raised by the Turkish Government, which have, however, since been overcome. The junior member of the expedition, Lieut. Kraft von Helmhacker, has, however, started in advance, in order to familiarize himself with the conditions of travel in the selected field. It appears that the scheme has been under consideration for several years, and that, both by his previous efforts to qualify himself for the task and the minute attention to detail bestowed on the actual preparations, Herr Artbauer has left nothing undone which might ensure the success of the undertaking. He has travelled over the whole domain of Arab culture in Asia and Africa, his last piece of work having been a three years' journey of research in Morocco, half of the time having been devoted to a thorough ethnological exploration of the Rif, the results of which have quite recently appeared in an important work entitled 'Die Heimat der Rifpiraten.' Besides his colleague Von Helmhacker, the leader has secured the services of a third Austrian, Herr Storch, who will take charge of the caravan during the absence of the leader on side excursions, it not being intended for the main body to visit Tibesti. Herr Storch has resided eleven years in North Africa, and his experience is likely to be valuable. When travelling, he throws off the character of a European and becomes a regular Arab. He is, besides, a competent zoological collector. It is proposed to start south about the end of March, at the conclusion of the rains, and a first trip which the leader proposes to carry out is one to Ghadames, which will offer an important field for geographical and cartographical work. After joining the rest of the caravan at Murzuk, Herr Artbauer will endeavour to enter into relations with some of the merchants who have dealings with Tibesti, and, while the caravan proceeds towards Lake Chad, he will make attempts to penetrate that country from the north or west, or, failing these, from the north-east, *i.e.* from Kufra. Whether successful or not in the endeavour to explore Tibesti, the travellers will rejoin the main caravan at

Kuka, in British Nigeria. After this, as we now learn, a further important piece of exploration is contemplated. It is proposed to make for Timbuktu, and recross the Sahara in its western portion, in part by the route of Oskar Lenz, which has not since been followed by any traveller. The expedition will, it is hoped, end its work in Morocco, after crossing the south-western section of the Anti-Atlas and Great Atlas. It will probably occupy from two to three years.

An Unpublished Account of the Red Sea by Filippo Pigafetta.—A man of great and varied attainments, F. Pigafetta is best known to geographers for his account of the ancient kingdom of Congo derived from the Portuguese adventurer, Odoardo Lopez. His contribution to geography is not, however, limited to this work, though his services, both in this and other fields, are less known than they deserve to be. Prof. Magnaghi has recently drawn attention, in the *Bolletino* of the Italian Geographical Society (1910, Nos. 2 and 3), to an unpublished narrative of Pigafetta's travels in the East in 1576–77, from which he has extracted the most important passages of the section dealing with the Red sea and Gulf of Suez, elucidating them by a full commentary. Having visited Mount Sinai and missed the chance of returning to Suez with the overland caravan, Pigafetta found himself at Tor, on the south-west coast of the Sinai peninsula, and decided to make the journey by sea. To this fact and to the delay caused by stormy weather, which lengthened the voyage from a possible 24 hours to 24 days, we owe a description much in advance of any contemporary one, and hardly bettered until the time of eighteenth-century travellers like Shaw, Pococke, and Niebuhr. Even the well-known narrative of the voyage of the Portuguese fleet, written by João de Castro in 1541, supplies far less information on the upper part of the Red sea. Besides mentioning a large number of places and attempting an identification of ancient historical sites, Pigafetta gives particulars of the nature of the coast and its orography, with observations on corals, and on the winds, tides, and navigation of that sea. Prof. Magnaghi enters fully into the questions of historical geography raised by the Italian writer, and shows that though the data at his disposal did not permit Pigafetta to solve all these quite correctly, his views about them were generally judicious. Thus he is the first to distinguish an Elanitic gulf to the south of Tor, for, strange as it may seem, the existence of the Gulf of Akaba was generally ignored, even by the Arabs, in his time. His conclusions as to the passage and further route of the Israelites are sensible, considering the means at his disposal, and it was not till long afterwards that any further light was thrown on the question. He is able to distinguish (as was not commonly done in his time) between the sites of Arsinoe and Heroopolis, and he is aware that the ancient canal did not unite the two seas, but only the Gulf of Suez and the Pelusiac arm of the Nile. He shows a clear understanding, too, of the *régime* of the winds in the northern part of the Red sea, and its causes. He considers the question of the name of the Red sea, which he derives from colour due to marine vegetation. As regards the Red sea proper, he gives much information as to the places on either side and the political status of the countries washed by it, though these were not actually visited by him.

AMERICA.

The Surinam River.—The Tumuc-humac expedition, which was reported in this *Journal*, was unable to reach the upper Surinam from the Brazilian frontier, or to ascend the river on its return northwards, and therefore an expedition under Lieut. Eilerts de Haan set out in June, 1908, to explore the upper course of the river, connect the triangulation of the eastern expeditions (Tapanahoni and Gonini) with the western (Coppename and Saramacca), and, if

possible, cross the watershed to the basin of the Corentyne river. This programme was successfully carried out. At Goddo two streams, the Gran Rio and the Pikien, unite to form the Surinam. The latter, the more southerly, was ascended first and bearings were taken from the Ananasberg, a granitic mass 1476 feet high. Than the longer Gran Rio was ascended, and from the Franssen Herderschee peak, 2460 feet, it seemed probable that the Wilhelmina range was not connected with the Tumuc-humac mountains, and this was proved to be a fact by observations further west. The peak is the most easterly summit of a range which runs south-westwards and afterwards north-westwards, ending in a lofty summit at a distance of some 30 miles. Ascending the river as far as it was possible in canoes, the expedition marched northwards to a peak 1624 feet high, and then westwards to the lofty summit already mentioned, which proved to be 2690 feet high, crossing on the way a river, to which the name of Lucie was given, and which is probably a tributary of the Corentyne. Schomburgk mentions no tributary in this latitude, but he descended the Corentyne without noticing the confluence of the New river, which is at least as large as the Corentyne itself. The Wilhelmina range extends from east to west for a distance of about 60 miles, with a breadth of about 25 miles. The southern range may or may not be connected with the Tumuc-humac mountains. In the interval between these ranges, 6 to 12 miles broad, lie the sources of the Gran Rio and Lucie, separated by a watershed of insignificant elevation. To the paper describing the exploration (*Tijdschrift K. Nederl. Aardrijksk. Genootschap*, Deel 27, Nos. 3 and 4) are appended details concerning the triangulation, a list of plants collected, etc. The country is thickly wooded, and the rivers are full of falls and rapids. We regret to learn that Lieut. de Haan has since died, when starting on a new expedition into the interior of Dutch Guiana.

Prof. Sievers's Explorations in the Source-region of the Amazon.—Although the general features of the region about the headstreams of the Marañon have long been delineated on our maps, much remains to be done in the way of improving the lesser topography, and still more, perhaps, in that of a scientific elucidation of the morphological character of the region. A contribution in both these directions has been made by Prof. W. Sievers, who returned in 1909 to the scene of his former geographical researches in Northern Peru and Southern Ecuador. The principal results of his studies are described in an article in No. 8 of the *Zeitschrift* of the Berlin Geographical Society for last year, illustrated by a sketch-map. The chief questions considered are those of the orographical system of the districts visited (lying mainly between 9° and 10° 30′ S., to the west of the upper Marañon), and of the true ultimate source of the latter river itself. Prof. Sievers insists on the essential unity of this section of the Andean Cordillera, though this does not prevent him from describing three separate parallel chains, viz. the Cordillera Negra running west of the upper Rio Santa (or Huaraz), the Cordillera Blanca between that stream and the Marañon basin, and a third forming the water-parting between the latter and the coast streams entering the ocean to the south of 10° 30′ S. His routes crossed these chains at various points, allowing an insight into their geological characters, and he is thus able to speak with confidence as to their mutual relations. For the most eastern of the three chains (which, though without a name on the maps, is described as one of the most imposing snowy ranges imaginable, and possessing the undoubted character of the main chain of the Cordillera) he proposes the name Cordillera de Huayhuash, as this recurs several times as a designation of special features connected with it. In regard, more particularly, to the two other chains, he

denies the existence of a mountain "knot" in which they coalesce, such as has figured in maps and books since Humboldt's time under the name "El nudo de Pasco." The Cordillera Negra maintains, he says, its distinct orographical character as far as the mountain region south of Cajatambo. Leaving on one side the question whether the Marañon or the Ucayali is to be regarded as the true upper branch of the Amazon, Prof. Sievers examines the claims of the various headstreams of the Marañon to be the most important. He decides in favour of the easternmost, or that issuing from Lake Lauricocha, thus substantiating the generally accepted view. Lauricocha is not, however, as commonly supposed, the ultimate source, for it is fed by a stream which drains a succession of still higher lakes. These are shown on the corrected version of Raimondi's map issued by the Geographical Society of Lima, but Prof. Sievers, who carefully examined the most remote head of the basin, was able to correct this map in some particulars, and to ascertain the precise topography of the ultimate source-region. He regards the true source to lie in the glaciers of Mount San Lorenzo in the highest part of the Cordillera of Huayhuash.

AUSTRALASIA AND PACIFIC ISLANDS.

Expeditions in Dutch New Guinea.—We are informed that the command of the British expedition in Western New Guinea, vacated by Mr. Goodfellow, has been given to Captain Rawling, to whose energy and determination the results hitherto attained, from a geographical point of view, are in great measure due. Captain Rawling may be trusted to do everything that is possible to overcome the great difficulties still to be encountered in the performance of the task of the expedition. At the same time we learn from the *Tijdschrift* of the Netherlands Geographical Society (November 15, 1910), that an allocation of 20,000 florins has been made in the Colonial Budget for 1911 in aid of a new expedition to the snowy range of New Guinea. Its leader will probably be Captain J. W. van Nouhuys, the companion of Dr. Lorentz in his successful ascent to the snows in 1909. In the north of the island, an expedition for ethnological and other scientific research has been undertaken by Dr. M. Moszkowski, with the aid of a grant of the Baessler fund of the Berlin Ethnological Museum. This traveller, who has already accomplished some exploring work in Sumatra, is proceeding up the Mamberamo river, an arm of which, debouching into Geelvink bay, he is said to have surveyed *en route*. From a note in *Globus* (vol. 98, p. 195), it appears that he hopes to push on to the snowy range, which Lieut. Herderschee was prevented from reaching (*Journal*, vol. 36, p. 497).

POLAR REGIONS.

Captain Bernier's Expedition.—We have been favoured with the copy of a letter received by the Deputy Minister of Marine and Fisheries at Ottawa, in which Captain Bernier announces his arrival at Pond's inlet on August 3 last. He was about to proceed *viâ* Salmon river to Beechey island, whence the voyage would be continued to Melville island. The further route would be either down Prince of Wales strait or down the western side of Banks island. The prospects of a successful voyage seemed favourable at the time of writing. If unable to reach Herschel island before winter set in, Captain Bernier proposed to winter in the best place to be found on the way.

Antarctic Expeditions.—News of the final departure of Captain Scott's Expedition in the *Terra Nova* for the Antarctic Regions was despatched from Port Chalmers on November 29. It is stated that, on reaching McMurdo strait, Lieut. Evans will hand over the command of the ship to Lieut. Pennell, himself landing with the greater part of the Western party and making preparations

for the great southern journey (to be begun in October of this year) by laying depôts. Meanwhile, Captain Scott will proceed with the *Terra Nova* to King Edward VII. Land, where he hopes to land the Eastern party, consisting of Lieut. Campbell and six men, returning thence to McMurdo strait. It is expected that Lieut. Evans will have started with a party of twelve men on the depôt-laying journey before the return of the ship, and that he will be away ten weeks. Various other expeditions for continuing the campaign in the Antarctic are still being talked of. One which has found some support in Australia is that suggested for the exploration of the continental coast west of Cape Adare, the leadership of which has, we understand, been offered to Captain J. K. Davis, late of the *Nimrod* (see December number, p. 696). Details of still another scheme are given at p. 103, *infra*. It is also stated that the idea of an American expedition, such as was proposed soon after Peary's return from the North Pole, and which had his support, is being once more taken up, this time by Captain Bartlett, who has expressed his willingness to lead such an expedition. The Japanese Expedition, set on foot by Lieut. N. Shirase, who proposes to make a dash for the South Pole with a singularly ill-equipped party, consisting of five men only, is stated to have started south on November 28, though reports had previously been circulated that its departure would be postponed.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

The Distribution of Temperature beneath Mountain Ranges.—Dr. Charles H. Lees, of the University of London, has been led to investigate this subject mathematically, on account of the importance attached by geologists to the distribution of temperature within the Earth's crust as a factor in producing movements of the crust, especially in the formation of mountain ranges. In a paper "On the Shapes of the Isogeotherms under Mountain Ranges in Radio-active Districts," published in the *Proceedings of the Royal Society* (Series A, vol. **83**, No. A563), he has, with as much clearness of expression as the abstruse nature of the subject permits, calculated for certain simple forms of mountain contour, the temperature distribution within the mountain mass, and drawn curves indicating the shapes of the isothermal surface (isogeotherms). It would not be possible in a brief notice to explain the series of equations leading up to the final results of the analysis, but the method of treatment and the results themselves may be broadly outlined. In order to render the problem more manageable, since as presented in nature it is too complicated to admit of mathematical treatment, certain simplifications are introduced; the mountain range being assumed, *e.g.*, to be of uniform height and shape, with a length great in comparison with the height and width, while its section is taken to be one of a few simple and typical forms. The rock constants involved in the equations, such as the values for heat-conductivity, radio-activity, the increase of temperature with descent into the Earth's crust, and the decrease of temperature with ascent up the sides of mountains, of course, vary in different districts, but an ideal case is worked out in detail in which these constants have approximately the mean of the values found experimentally. It appears that under a mountain range the isogeotherms are convex upwards, as indeed elementary knowledge would lead us to expect. If the rock is not radio-active, the excess of temperature at a point under the summit of the range and at the same level as the neighbouring plain above that of the surface of the plain is $(a-a')\frac{H}{1+\frac{H}{d}}$, but if the rock is

radio-active, the excess is $(a - a')(1 + BH)\frac{H}{1 + \frac{H}{d}}$, where H denotes the height of the mountain range, a increase of temperature with descent into the crust, a' decrease of temperature with ascent up the mountain-sides, B is a symbol for an expression $\frac{w}{2K(a-a')}$ (w = radio-activity, k = heat-conductivity), and d is the expression $\sqrt{\{(H-h)^2+b^2\}}$, in which b = half the width of the range, and h = $\frac{1}{2}$H, the height of the range as aforesaid. The term introduced by radio-activity is very small, so that the small amount of radio-active matter normally present in rocks has little effect in disturbing the shape of the isogeotherms beneath ranges of moderate height, and may be neglected. Dr. Lees' calculations do not support those of Fisher, who, in 1889, concluded that the shape of the surface of a mountain range does not appreciably affect the temperature gradient from the summit downwards, and that mountains have solid roots beneath them projecting into a substratum of molten rock.

GENERAL.

Commemoration of Matteo Ricci.—The third centenary of the death of the famous Jesuit missionary to China, Matteo Ricci, falling in 1910, arrangements were made to celebrate the occasion, both in connection with the recent meeting of the Congress of Orientalists at Macerata, and by the publication of a "National" Edition of his 'Comentari' and 'Lettere dalla Cina.' The original manuscripts of these were lately discovered at Rome by Padre P. Tacchi Venturi, to whom the editorship of the work has been entrusted. It will form two volumes, and will, it is hoped, be completed in time to be presented to the International Geographical Congress in Rome next year.

OBITUARY.

Hormuzd Rassam.

The death of Mr. Hormuzd Rassam, at his house at Hove, on September 8, 1910, deprives the Royal Geographical Society of one of its older and more distinguished Fellows, and closes an unusually varied and adventurous career. Mr. Rassam was a native of Mosul, and was born on the banks of the Tigris in 1826. His people, Nestorian Christians, were of some distinction locally, and his brother Charles became British Vice-Consul at Mosul itself. Hormuzd Rassam was only in his twentieth year when his chance came. The researches of M. Botta, the French Consul at Mosul, on ancient sites at Kouyounjik and Khorsabad, had already revealed the possibility of recovering great monuments of Oriental art, and had laid the foundations of the Assyrian collections of the Louvre. In those days the British Government had fewer scruples than now, in devoting public money and political influence to the encouragement of this kind of research; and Mr. (afterwards Sir Austen) Layard, who had been in close correspondence with Botta since 1842, went out himself in 1845 to excavate Nimrud, on behalf of the British Museum. One of the first requisites of such an expedition is an active, intelligent, and trustworthy native to train the local workmen to Western methods and precautions, and to initiate the European explorer, no less, into the habits and traditions of the East. This was young Rassam's opportunity. He was hardly more than a boy, but he had obviously intellect and character

above the average; and he developed rapidly that almost instinctive skill in locating ancient remains, and, as it were, seeing into the heart of an unexcavated site, which is found now and then among Orientals of all ranks and races, and is the envy and despair of European diggers. To this archæological instinct Rassam added untiring industry and patience, great organizing ability, skill in managing his men, and a capacity (invaluable in the East) for concealing his ultimate aim, while he laid and carried out his plans, which gave him an almost magical repute among his countrymen. No appearance of previous exhaustion by earlier diggers deterred him if his instinct told him that a mound held something still to find. "If it was not at the top, it must clearly be lower down," he would argue; and "lower down" his treasure usually would be found. He had also, as the event proved, the imagination to know for what to look: his crowning discovery, the storehouse of clay-tablets which formed the royal library of Assurbanipal, is a striking instance of this; and his happy conjectures of the plan and architectural peculiarities of the palaces which his mounds concealed were of the first importance at this earliest stage of the subject.

Layard himself was only able to superintend the excavations at Nimrud, from 1845 to 1847; but before his departure his foreman had made himself indispensable, and when Layard returned in 1849, with fresh funds and a wider commission, Rassam was associated with him as second in command, at Nimrud again; at Kouyounjik, one of Botta's sites; and also at Babylon and Niffer.

But with the Crimean war the heart of the Turk was hardened, and public interest in England was diverted. Funds and facilities dwindled, Layard's mission came to an end, and Rassam was transferred to a Government post at Aden, where eventually he became assistant to the Political Agent, and represented this country at Muscat during the disturbed incidents of 1861.

It was a strong testimony to the confidence and respect with which Rassam was held, that he was selected in 1864 to represent to King Theodore of Abyssinia in a friendly way the determination of Great Britain to protect effectively the European residents, whom that king had wantonly imprisoned and insulted. There was every desire on our part to vindicate our claim without resort to force; and for a while it seemed as if Rassam had gained his point, for in February, 1866, the prisoners were released. But in April other counsels prevailed, and not only the former prisoners were seized again, but Rassam himself was imprisoned and put in irons. The sequel is well known: Sir Robert Napier's expedition reached Magdala in due course, and on April 11, 1868, the prisoners were surrendered.

After these privations Rassam's continuous service came to an end, and he retired with a pension at the end of 1869. It was in this year, too, that he was elected Fellow of our Society. It was, however, not long before he was in his old field again. In the early seventies, conditions were favourable once more to archæological work in Mesopotamia, and the many-sided activity of the *Daily Telegraph* found issue in an expedition to Kouyounjik under George Smith. The British Museum came again into the field, and after the return of George Smith in 1876, Rassam, who was already engaged on behalf of our Constantinople Embassy in an inquiry into the state of the Christian communities in Asiatic Turkey, was appointed to carry on the work at Kouyounjik, Nimrud, and other sites. He visited Babylonia again, and was fortunate enough to identify the site of Sippar, one of its most famous cities. In pursuance of his original commission, he penetrated also into Armenia on his way home, and made important discoveries in the neighbourhood of Lake Van. The principal objects from all these journeys are to be seen in the British Museum.

This was his last systematic expedition. Differences of opinion between himself and a member of the British Museum's staff culminated, in 1893, in an action brought by Rassam for alleged libel and slander caused by criticism of his conduct while in charge of the Museum's excavations. Rassam won his case and some small damages; but further co-operation with the museum was clearly out of the question: Rassam himself was already an elderly man, and the later years of his life were spent in retirement on the south coast.

Rassam was by nature more explorer than student, and his active life, largely spent in the field, gave him little leisure for learning or for literary work. His 'Narrative of the British Mission to Theodore, King of Abyssinia,' contains, besides its main topic, an account of travels in Sudan and the Amhara. The record of his early work with Layard is incorporated, of course, in his leader's fascinating narrative, and in official monographs; but a paper on "Babylonian Cities," read before the Victoria Institute in 1884, was expanded in 1897 into a popular and fully illustrated book, entitled 'Asshur and the Land of Nimrod.' He contributed also a few papers on special topics to the *Transactions* of the Society of Biblical Archæology and other Societies, and a memorandum, in 1893, "On the Preservation of Assyrian and Babylonian Monuments" to the Ninth International Congress of Orientalists.

J. L. M.

Theobald Fischer.

After a long and severe illness, Prof. Theobald Fischer died on September 17 last, at Marburg, as the result of a heart attack. His friends had thought that his iron will might once again have triumphed over the body, and he had himself hoped to obtain a cure for his malady through a winter sojourn in his beloved Italy, under the southern sun of Palermo; but he was not able even to begin the journey. In his person, one of the most striking figures has been removed from the ranks of present-day geographers—one who has exercised no small influence on the development of modern geography. But like so many geographers of the older generation, who have approached the subject through another science, Fischer had been but a late recruit to geography.

Born a yeoman's son on October 31, 1846, at Kirchsteitz near Zeitz, in Thuringia, he began his education there in the village school, passing at ten years old into the Gymnasium at Zeitz, and at eighteen beginning his University career, first at Heidelberg, afterwards at Halle, where he threw himself at once with ardour into the life of a student. Under Dümmler's guidance at Halle he devoted himself to serious historical studies, and in 1868 proceeded to the degree of Doctor at Bonn with a Latin historical essay. He then took a tutorship at Klein-Mariazell in Lower Austria, and this was the beginning of a long period of wandering, during which he traversed the greater part of Europe, and in particular made himself thoroughly acquainted with the Mediterranean countries, to the study of which he devoted all his later life. To these years Fischer always looked back with special satisfaction, and it was they which made him a geographer. In 1871 he went to Brussels, still as a private tutor, and eventually to Paris. In 1876 he qualified as Privatdozent at Bonn with his 'Beiträge zur physischen Geographie der Mittelmeerländer.' In 1879 he became professor at Kiel, and in 1883 at Marburg, where he continued to labour till his death.

Theobald Fischer's name will for all time be bound up most intimately with the "Mediterranean lands," a conception actually originated by himself. To

this region, which he came to know in its whole extent from personal observation, practically his whole activity in the *rôle* of a scientific investigator was devoted. Still he was one of the few geographers able to take a survey over the whole field of the science, as was abundantly attested by his courses in regional geography, which had not their equal for consistent mastery of the most varied material. But he felt a strong repugnance to publishing anything, with the subject-matter of which he did not feel himself absolutely at home. His masterpiece is his contribution to Kirchhoff's 'Allgemeine Länderkunde' in the form of a geography of the Southern European peninsulas, a work which has been both suggestive and fertile in results from the point of view of methodology. Only those who have themselves entered the lists in this field can form a just conception of the extraordinary difficulties which must have been involved in the writing of this work. The section dealing with Italy was translated into Italian, in much extended form, some years ago, under the title 'La Penisola Italiana,' and won its author the highest scientific distinction that Italy has to offer, viz. membership of the Accademia dei Lincei. Much regret was expressed in the Italian papers on the occasion of Fischer's death that the Italian geographers had never come to the point of a synthesis of the geography of their country, and that the only scientific description of it from this point of view had been from the pen of a foreigner.

Fischer had desired to crown his life's work with a similar description of the Atlas lands, in which, to say nothing of minor journeys, he had carried out three important research expeditions, and covered many hundreds of miles with his surveys. The material is available in its entirety, and only the master hand is wanting for its arrangement. The most valuable of his lesser writings are collected into the two volumes of his 'Mittelmeerbilder.' They show the all-round character of his output, dealing as they do with all branches of geography—morphology, climatology, oceanography, biogeography, and first and foremost with anthropogeography, to the study of which he had applied himself with special zest in his later years, and for which his early historical studies proved an excellent foundation. The Mediterranean lands with their old civilizations are indeed the very field to quicken the view of the geographer for the relations between man and his habitat, and while, for example, it makes little difference to the geologist *where* a rock comes from, or *where* a given stratigraphical horizon crops out, such lands possess quite a particular interest for the geographer. Many of Fischer's lesser writings are gems of geographical literature, regarded from the point of view of their masterly form.

As a teacher Fischer's career was unusually active and fruitful. The number of his pupils, with whom his relations were always marked by warm human sympathy, was very large, though he has left behind no actual school of adherents. But the force of his magnetic personality can never be forgotten by those who had the good fortune to be brought into close contact with him.

A. Ruehl.

CORRESPONDENCE.

A Proposal for a New System of Exploration in the Antarctic Regions.

Throughout the history of exploration it has always been the coasts of new lands which have most attracted the explorer, and most interested the world at large, and for more than a century repeated attempts have been made to map out the coast-line of the great Antarctic continent. It is only within the last few decades that so much time and effort have been wasted in the pursuit of the pole.

The coast-line of Antarctica is by far the most interesting part of the continent; for while *it* is composed of noble mountain ranges, the interior is undoubtedly formed of a vast, featureless snow plain. Yet in spite of the splendid amount of work that has been done on the Antarctic coasts, the sum-total of results, so far as the map shows, is rather meagre. The patches of land which appear on the map are comparatively limited in extent, detached, and somewhat vaguely defined. The reason for this is, I take it, that all the work of discovery in this region has been done hitherto from ships, and, besides the fact that an accurate topographical survey cannot be conducted from a ship, there is this special difficulty, that the Antarctic pack-ice is so heavy, and clings so closely to the shore, as to make navigation in these waters always extremely hazardous, and sometimes frankly impossible.

Few explorers in this region have yet been bold enough to cut themselves boldly off from their ship, and do their exploring by means of dog-sledges, trusting to the teeming animal life of the country for sustenance. Yet most of the Arctic archipelago was explored in this way; and Nansen, in the extreme north of Franz Josef Land, spent fifteen months, with a single companion, completely cut off from his ship, and with no certainty of relief ahead of him. He lived during most of this time on walruses and bears; and these animals are less plentiful and far more difficult to catch and kill than is the Weddell seal in the south.

I propose, then, to explore the Antarctic coasts with a small party, provided with sledges and dogs, travelling mainly on the sea-ice, and relying on the Weddell seal for most of their food and all their fuel. The Weddell seal is found in swarms all round the Antarctic coasts for the greater part of the year, and sometimes even in the depths of winter. His flesh, liver, and blood form excellent palatable food, and his blubber can be used to cook this food. Our party had best consist of six good men—the leader, who should be a navigator and surveyor, the second in command, who should also be a navigator, a geologist and mineralogist, a surgeon, and two handy men, who should have some experience of dog-sledging. Only three sledges will be needed. They should be strongly built, of the Nansen pattern, and designed to carry a load of 800 lbs. The party will take twenty-four dogs.

Since we shall rely on being able to procure an unlimited supply of animal food in the country through which we travel, no meaty or fatty foods need be included in the sledge-load, and no cooking oil need be taken either, for seal-blubber will take its place. The daily ration then, consisting of biscuit, tea and sugar, can easily be cut down to one pound per man. No food will be taken for the dogs. They can be fed on our leavings, after butchering the seals for our own use. If we allow 150 lbs. each sledge for constant weights, we can carry 325 days' rations for the party on the above scale. Four hundred and fifty pounds seem a small weight of non-consumable stores for six men for a year. I will therefore give a rough idea of how I propose to allot it.

Weight allowed	450 lbs.
Scientific instruments	150 ,,
Tent and poles	30 ,,
Six sleeping-bags	60 ,,
Spare clothing, 20 lbs. each	120 ,,
Aluminium cooker	10 ,,
Aluminium stove	10 ,,
Three ice axes	12 ,,
Alpine ropes, 120 feet	12 ,,
Two spades	10 ,,
Repairing gear	20 ,,
Total	434 ,,

The scientific equipment must include—a theodolite, a plane-table, a prismatic compass, a hypsometer, an aneroid, half a dozen thermometers, and at least two cameras with films. To this add a large quantity of stationery. Of course all instruments will be specially built with a view to lightness. In addition to these articles on the sledge, each member of the party will carry a chronometer watch on his person, a skinning knife at his belt, and a ruck-sac on his back. This last item may be cavilled at, but my experience is that a weight of twenty pounds or so, carried in a well-fitting ruck-sac, is hardly felt at all, at any rate when moving at a walking pace.

The tent will be a light one, and may not last for quite a year of wear and tear; so the party must practise themselves in the construction of snow huts while it is still sound, so that they may rely on this form of shelter when it is worn out.

The system of surveying will generally be as follows: The party will set out from a known point, which will be fixed as accurately as possible. A theodolite will be planted on this point, and a round of angles taken. A cyclometer will be attached to each sledge, and the sledges will advance from the fixed point in a straight line in a known direction as far as the nature of the ground will permit, when the theodolite will be used again. In this way a base-line can be measured with sufficient accuracy, without delaying the advance. This method could not be followed were the ground rough, but most of the Antarctic "fast ice" is much smoother than that described by Peary, Nansen, and others in the north.

Of course, observations for latitude and longitude will be taken from time to time.

I will now discuss the difficulties and dangers which our party are likely to meet with on their journey. The most serious of these will probably take the form of a lofty range of mountains with steep seaward slopes, ending in sheer cliffs, without sea-ice at their base. Happily for us, the Antarctic coastal ranges have generally a tract of undulating ground, or foothills between them and the sea, but here and there things will be found to be as I have described, the steepness of the slopes and cliffs rendering the passage of sledges quite impossible. Granted, then, that this obstacle is impassable, our only course is to circumvent it. This can be done by piercing the mountain ranges, and ascending to the plateau behind them by way of a glacier, and descending to the sea again by another glacier. Most of the Antarctic glaciers present a fairly good surface for sledging. The objection to this plan will be that the party cuts itself off from the sea and seal-meat. So they must provision themselves with, say, ten days' supply of meat before leaving the coast.

Now suppose this difficulty left behind, and that the party has emerged on a huge plain of barrier ice. Here we may expect to make long marches, owing to the uniformity of the surface; and we will be able to calculate the day's run ahead with certainty. The main difficulty again will be the getting of seal meat; for such barriers always end at the water's edge in inaccessible cliffs from 20 to 200 feet high. But in these cliffs there will be found here and there huge fissures, or *barrancas*, as we called them, which are really a stage in the calving off of an immense iceberg. These fissures are floored with sea ice, and on this ice the seals congregate in swarms to rest and bask, because there is no resting-place for them elsewhere along the barrier edge. At such places the party must halt and load up the sledges with a week's supply of meat. They must then advance for four days (80 miles, for the going will be easy), and then, if they do not find another place to re-victual, or see signs of it ahead, they must come back, take a fortnight's food on board, and start again.

The greatest *danger* to which the party will be exposed will be that of being carried out to sea on an ice-floe. But this danger, though it is a very real one, may be exaggerated. I know of two cases in which such an accident has happened in the south without loss of life, and people think little of it in the north. Nansen with his party, who made the first crossing of Greenland, spent eighteen days on drifting floes, and at the end reached land safely and without losing a stick of his equipment.

The Antarctic pack is generally so dense as to completely hold up a powerful ship. If this is so, then it is safe for sledge-travel.

Though my system of exploration might be applied to any part of the Antarctic coasts, the region which I am most anxious to investigate is that lying between Graham Land and King Edward VII. Land, and the distance between these two places is roughly 2000 miles. I will state our average day's run at 10 miles—a very low average, for on good ground we ought to be able to cover 20 miles in a day with the utmost ease. Our journey then could be completed in 200 days supposing that we could hold a fairly straight course. Now, though it is absurd to expect that our journey will be anything like straight, yet I think we have reason to suppose that the Antarctic continent has a fairly regular margin, like that of Australia. We shall generally be able to cross sea-inlets, like McMurdo sound, on the ice, and (an important point) I expect the larger indentations of the coast-line to be filled up with barrier-ice.

I believe that a ship should be able to land the exploring party in Graham Land or Alexander I. Land about the beginning of December. The party would start westward into the unknown as soon as landed. They would hope to make good 600 to 700 miles of westing before they were forced to go into winter quarters, which need not be till about the end of March. The travelling at this time of year will be difficult, for the sea-ice will have gone out, or will be untrustworthy.

The winter will be passed in a snow hut, and a good supply of seal meat will be laid in before the winter comes on. It is quite possible, in the region in which we should find ourselves about this time, that the site of our hut will be in a latitude little above the Antarctic circle, and so we may hope that the winter night will not be long, and that we shall not have to endure any great extremes of temperature. At Cape Royds, during the winter (southern) of 1908, the thermometer seldom fell below $-40°$ F.

It is in the spring that our best work should be done, for now the sea-ice will be solid and hard, and long marches may be expected. We should break up our winter camp not later than the middle of September, and, with any luck, we may expect to reach King Edward VII. Land not later than the end of December. Arrived here, the party will not be at the end of their difficulties, for the ship may not be able to reach the land, or she may have met with disaster. It will be well, therefore, to agree to a rendezvous on the edge of Ross's Great Ice Barrier in, say, long. 165° W.—that is to say, about 50 miles west of King Edward VII. Land. The barrier here is low, and there should be no difficulty in communicating with the ship. If she does not turn up before the end of January, the party must strike out boldly across the Great Ice Barrier for Shackleton's hut at Cape Royds.

I am not speaking lightly when I say that this should prove a comparatively simple part of our adventure. The distance to be traversed is not more than 350 miles, and there are no obstacles in our path. Our supply of biscuits will have fallen so low that we need only take two sledges. Supposing two-thirds of our dogs to have survived, there will still be eight dogs to a sledge. I will hope to do at least 15 miles a day on the barrier surface. I shall therefore take 21 days' rations at two and a half pounds per man and one pound per dog per day. This

comes to about 326 lbs. weight of provisions per sledge. Our original weight of non-consumable stores, now considerably reduced, to which we must add a certain weight of geological specimens, should not bring the sledge-load up to more than 700 lbs. Our food-supply can be replenished at Cape Crozier, and we should be able to work our way over the lower slopes of Terror and Erebus in three or four days, and so down on Cape Royds.

Here at last we can rest with easy minds. We have a roof above us and four stout walls around us. We have added 2000 miles of territory to the world's map and to the British Empire. Besides the scientific interest of our geological work, its economic value must not be set aside, for it is wrong to suppose that the Antarctic continent must ever remain uninhabitable. Where precious metals are found, a population will soon be found.

On our expedition, as I see it, we need never be short of food or fuel. I admit that our clothes and equipment may be sadly worn before the end of our year's journey, but if the worst comes to the worst we can make warm foot-gear and jackets out of seal and penguin skins.

I think that the total cost of the expedition need not amount to more than £20,000.

Lastly, and most important, my plans could be admirably put in execution, in connection with, or as a part of, such an expedition as Dr. Bruce proposes.

A. Forbes Mackay
(Member of Sir Ernest Shackleton's Expedition).

Dr. Mackay's proposal to explore the continental coast-line of the Ross Quadrant should be cordially welcomed by geographers. On several occasions, especially in my paper respecting Antarctic routes, and in my paper read at Berlin, I referred to such an undertaking as comprising work of the greatest interest and importance. I had looked forward to the unknown coast of the Ross Quadrant being undertaken from the direction of Edward VII. Land, by a journey at least as far as the meridian of Peter island. His late Majesty gave his approval to the extensive continental land discovered by Captain Scott receiving the name of King Edward VII. Land, in a letter dated May 9, 1903. If Captain Scott succeeds in the very difficult attempt to land a party under Lieut. Campbell, R.N., on King Edward VII. Land this season, the examination of the western part of the Ross Quadrant will be provided for. Assuming that the coast-line is continuous, it will be convenient to call it the Edwardian coast. Dr. Mackay proposes to commence his exploring work from the eastern end of the Quadrant, near the meridian of Graham Land.

It is desirable to consider the few facts we possess which may indicate the parallels of latitude occupied by the Edwardian coast, and the character of that coast. The furthest point seen of King Edward VII. Land was in about 76° S. and 148° W., with land trending northwards towards Cook's furthest in 72° 10′ N. and 106° 54′ W. Here Cook was at the edge of the pack, and saw ninety-seven icebergs like a ridge of mountains one above another, until lost in the clouds. Bellingshausen also reached 70° 3′ further east. The Belgian Expedition discovered a submarine plateau (75° to 103° W.) in 270 fathoms, with an abrupt descent to 800 fathoms. The apparently grounded bergs of Cook and the continental shelf of the *Belgica* appear to favour the probability that the Edwardian coast eastward of Cook's furthest is not much further south than the 72nd parallel. This is favourable for Dr. Mackay's plan, for the further that coast extends to the north the more likely it is to be connected with Graham Land. If this is the case a ship could land his party at the most southern point that can be reached

on Graham Land, enabling him to proceed at once on his journey. If not, and an ice-laden sea intervenes, the difficulty of reaching the Edwardian coast in a ship would be very great, with dog-sledges scarcely possible.

There is very little to indicate the character of the Edwardian coast. Judging from the analogy of other Antarctic lands, there are probably ranges of ice-cliffs, broken at long intervals. The number of icebergs seen by Cook and others seems to favour this view, which is the assumption of Dr. Mackay. But the steady drift northwards, seen by the *Belgica* not far from Cook's furthest, seems to point to a good deal of open water near the coast during the navigable season.

Turning to Dr. Mackay's plan for overcoming the difficulties that can be foreseen, he intends to rely upon the animal life assumed to exist along the route for his solid food. This, no doubt, is unavoidable, for the distance is much too great to enable him to carry provisions on his sledge. The main difficulty will be the encountering of open water, which cannot be got round. Dr. Mackay's proposed remedy is to ascend a glacier to the ice-cap, travel over it until the open water is passed, and then to descend by another glacier. Three weeks will probably be occupied in the ascent of the glacier. The glaciers may be 100 miles apart, for which another fortnight must be allowed, and then there is the descent of another glacier if another is found. The plan appears to me to be far too precarious and doubtful for adoption, without any other alternative.

I believe that the adoption of some method of crossing open water is absolutely essential. McClintock arranged to turn his sledges into boats by having four stanchions at the angles and stretching painted canvas round them and over the floor. Mikkelsen crossed lanes of water by passing painted canvas under his sledge. Berthon's collapsible boats would serve well to tow sledges prepared for the water. Inventive talent ought to be able to devise something lighter and better than the boat sledge of any former plan, and easier to parbuckle up on the floe again. For some plan for crossing open water is necessary.

A vessel for embarking the party on reaching McMurdo Sound must, of course, be provided.

The scheme entails great and serious risks. But it is certainly feasible, and the great importance of the results justifies these risks. The discovery of the Edwardian coast and its nature will go far to complete our knowledge of the Antarctic lands as regards their general outline, and much valuable information may be expected respecting the geology of a vast area. I look upon the connection of Graham Land with King Edward VII. Land as one of the great remaining polar achievements, and I believe that it can be only done satisfactorily in the way proposed by Dr. Mackay—that is, by sledging along the coast. The risks, it is not to be denied, are great, the rewards are greater. Geographers will wish the young and ardent explorer all possible success. The difficulties are serious but they can be overcome.

CLEMENTS R. MARKHAM.

November, 1910.

Mr. Huntington on Climatic Oscillations in Kharga Oasis.

THE note on "The Kharga Oasis and Past Climatic Changes" in the December issue of the *Geographical Journal* has directed attention to the extremely interesting paper entitled "The Libyan Oasis of Kharga," published by Mr. Ellsworth Huntington in the September number of the *Bulletin* of the American Geographical Society. Mr. Huntington remarks that few places offer better opportunities than Kharga for testing the various theories as to climatic changes,

and, on the basis of the facts furnished in my work, 'An Egyptian Oasis,' he comes to the conclusion that the evidence justifies the assumption that within historic times there have been marked pulsations of climate in the region, corresponding to those which he has formulated as having occurred in western and central Asia.

Mr. Huntington speaks in the kindliest of terms of my work on the "Oasis of Kharga," and his generous appreciation of the reliability of the facts therein set orth makes me feel genuine regret that I cannot see my way to endorse the main conclusion at which he has arrived. As Mr. Huntington remarks, I have not discussed, in my description of the oasis, the climate of historic times, but I can assure him that this omission was for neither of the reasons he suggests. Rather was it because the thought never crossed my mind that the data which I had collected and set forth concerning the ruins, sand-dunes and water-supply, could lead to any other conclusion than that which was perfectly well established in my own mind, *i.e.* that the climatic conditions throughout historic times had remained essentially the same as those which obtain to-day. After reading Mr. Huntington's paper, I realize that it would have been an advantage in some ways had I taken pains to clearly express my own views on the matter; at the same time I am glad I did not do so, because, much as I differ from his conclusions, I recognize the great value of his paper, based as it is on an independent study of the facts furnished in my book.

It is quite impossible for me at the present time to discuss the many deductions drawn from the facts which I have collected; I propose, however, soon after my return to England, to put on record my own interpretation of the latter, which will, I think, show that extreme caution must be exercised in accepting the inferences which Mr. Huntington has drawn as to past variations of climate.

As regards the hypotheses put forward by me to account for the lakes which I have described as occupying the lower portions of the depression of Kharga in historic times, I readily admit the force of Mr. Huntington's criticisms. As a matter of fact, several considerations, which have independently occurred to me since my book was published, have inclined me to modify the views I originally held. I believe it is the case that a very considerable part of the deposits in question is formed of wind-carried material, but at the same time I think that the latter was, to a very great extent, laid down under water. In this connection I need only draw attention to the remarks with which I originally summed up the subject: "A more detailed examination of the lacustrine deposits would probably throw further light on the matter; and a minute analysis of the nature, composition, and arrangement of the original grains would almost certainly show whether the beds have in the main been formed of sediment carried into the lake by streams from the neighbouring cliffs and plateaux, or whether they represent wind-borne accumulations of sand and clay-dust from the surrounding plains."

H. J. Llewellyn Beadnell.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1910–1911.

Second Meeting, November 21, 1910.—H. YATES THOMPSON, Esq., Vice-President, in the Chair.

ELECTIONS :—*Hugh Adams ; Wm. V. Alford ; Henry M. Ami ; Lieut. G. H. Anderson* (*18th Hussars*) ; *Chas. August Asker ; Leycester Aylmer* (*Lieut. King's Royal Rifles*) ; *Sydney Hiram Baker ; Stanley Baldwin, M.P. ; Major Sir Alexander Bannerman, Bart., R.E. ; His Highness the Gaekwar of Baroda ; Lieut. Henry Beaumont,* (*Lancs. Fusiliers*) ; *Lieut. Harry Gordon Bell, R.E. ; Joseph Bentley ; Francis Howard Bickerton ; Rev. William Brock, B.A. ; Robert Francis Bryant ; H. F. S. Butt-Gow ; Frederic King Butters ; Henry R. Cattarns ; Arthur W. Trevelyan Channell ; Thomas Clapham ; Rev. Chas. Cowley Clarke ; Herbert T. Clark ; Arthur Edward Cleaver ; Capt. A. Cole* (*The Carabiniers*) ; *A. Hall Cornish-Bowden ; Lieut. J. H. M. Cornwall, R.F.A. ; E. Costley-White ; Herbert Ernest Crabbe ; John Edward Crick ; Lieut.-Col. Harry Dade, T.F. ; Sir John D. Denison-Pender, K.C.M.G. ; E. Tennyson d'Eyncourt, M.A., J.P. ; J. Nicolas Dracopoli ; Henry Driver ; Islay Ferrier Drysdale ; Robert Dunsmore ; Lawrence Mathew Earle ; Thomas Alfred Edwards ; Somers Howe Ellis ; Dr. Josef Erb ; Alfred Ezra ; Francis George Fass ; Francis Cresswell Fforde ; Edward Fleming ; Sir John Gladstone, Bart ; Maurice Graham ; Major G. H. Griffith, R.E. ; J. William Hambleton ; R. C. Hargreaves ; William Y. Harkness ; Capt. Austin Hayward, R.A. ; Frederic Arthur Hertzel, C.B. ; Michael Holroyd ; Edward W. Dorland Holway ; C. Hilton Hutchinson ; Arthur Joseph Ireland ; Charles van Isschot ; Lieut. Chas. Joseph Keily, R.N.R. ; Capt. Arthur Salisbury Lawrence ; William Egbert Leveson ; Scott Lings ; Percy Gordon Loch ; Frank Longland ; Stanley Lord ; Gerald Lysaght ; Cecil Mack ; Col. Kenneth Mackay ; Archibald Douglas Maclean, J.P. ; Donald MacKenzie MacRae ; Capt. Wm. Evelyn Maples* (*Duke of Wellington's Regt.*) ; *F. Vernon Bruce Miller ; Dr. Raymond Boileau Mixsell ; John Edward Monk ; Allen Moore ; Charles L. G. Moore ; Adrian Charles Moreing ; Lieut.-Col. John Murray ; Charles F. Neumann ; Libert Oury ; Stanley H. E. Ouseley ; Howard Palmer ; James Unitt Parkes ; F. Courtland Penfield ; J. M'Farquhar Petters ; Sir Patrick Playfair, K.C.I.E. ; Charles Arthur Reid ; Wheatley A. Robertson ; Cyril Murray Robinson ; Rev. Alfred J. Rolfe ; Albert Augustus Scanlan ; T. Sheppard ; P. Smith Broome ; A. de C. Sowerby ; Arthur Purdy Stout ; Capt. C. K. C. Stuart, I.A. ; Sub-Lieut. E. Wm. Swan, R.N.V.R. ; Major Swinford ; Claude Trevine Symons ; Major Sir Thos. S. Tancred, Bart. ; P. C. W. Tatton-Tatton ; Austin Taylor, M.P. ; Frederic W. Taylor ; Wm. Taylor ; Count Paul Teleki ; Major-General Sir A. Turner, K.C.B. ; Wm. Denham Verschoyle ; Rev. H. Edgar Wall ; George Hilbury Warne ; A. F. G. Warrington ; Rev. Tetsushin Watanabe ; Lieut. G. G. Waterhouse, R.E. ; Mark Antony H. Watson ; Edgar Newton Waugh ; Hon. M. de P. Webb, C.I.E. ; Harold Ernest Weber ; Clifford W. Wheeler ; Norman Withers ; Joseph Henry Worth.*

The paper read was :—

"The Duke of the Abruzzi's Karakoram Expedition." By Dr. Filippo de Filippi.

RESEARCH DEPARTMENT.

November 17, 1910.—Prof. J. L. MYRES in the Chair.

"Origin of the Present Geography of Northern Nigeria." By Dr. J. D. Falconer.

Third Meeting, December 5, 1910.—MAJOR LEONARD DARWIN, President, in the Chair.

ELECTIONS.—*Colonel G. H. Fowke, R.E.; Captain P. V. Jackson; Sir Frederick O. Macmillan; E. A. Samson; Walter Woodbine Parish; Walter Louis Schnaider.*

The paper read was:—

"The Duke of the Abruzzi's Karakoram Expedition." By Dr. Filippo de Filippi.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Austria—Lower Austria—Climatology. *Met. Z.* **27** (1910): 341-354. **Defant.**
Ergebnisse der Beobachtungen des niederösterreichischen Gewitterstationsnetzes in den Jahren 1901 bis 1905. Von A. Defant. *Map.*

Denmark—Pilot.
Den Danske Lods udgivet af det Kongelige Søkort-Arkiv. Syvende Udgave. Copenhagen, 1910. Size 10 × 6½, pp. 651. *Plans and Illustrations. Price* 4.00 *Kr. Presented by the K. Danske Søkort-Arkiv.*

Europe—Communications. *Ymer* **30** (1910): 168-174. **Åsbrink.**
Ångfärjelinjen Trelleborg-Sassnitz. Var direkta förbindelse med kontinenten. Af Gustaf Åsbrink. *Sketch-map and Illustrations.*
On a train-ferry across the Baltic (cf. *Journal*, vol. **31**, p. 410).

France—Brittany. *B.S.G. Lille* **53** (1910): 345-358. **Coulon.**
Les Paysages bretons. Par M. Marcel Coulon.

France—Durance. *B.S.G. Marseille* **33** (1909-10): 343-362. **Wilhelm.**
La Durance. Utilisation de ses eaux et Amélioration de son Régime par la création de Barrages. Par M. Ivan Wilhelm. *Map.*

France—Gard. *Spelunca* **8** (1910): No. 60: pp. 54. **Mazauric.**
Recherches spéléologiques dans le département du Gard, 1904–1909. Par Félix Mazauric. *Sketch-maps and Plans.*

France—Mountain economy. **Descombes and Girard.**
B.S.G. Comm. Bordeaux **33** (1910): 21–39, 233–245.
L'Association Centrale pour l'Aménagement des Montagnes. Par Paul Descombes et J. M. Girard. L'Aménagement des Montagnes. Par Paul Descombes.

France—Seine. *La G., B.S.G. Paris* **21** (1910): 409–420. **Maillet.**
Le régime hydrologique du bassin de la Seine et les crues de janvier-février 1910. Par E. Maillet. *Sketch-map, Plan, and Diagrams.*

France—Shellfish. *B.I. Océanog. Monaco*, No. 170 (1910): pp. 14. **Guérin-Ganivet.**
Notes Préliminaires sur les Gisements de Mollusques comestibles des côtes de France. La côte méridionale du Finistère comprise entre la pointe de Penmarc'h et la pointe de Trévignon. Par J. Guérin-Ganivet. *Map.*

France—Shellfish. *B.I. Océanog. Monaco*, No. 172 (1910): pp. 12. **Joubin.**
Etudes sur les Gisements de Mollusques comestibles des Côtes de France. La baie de Saint Malo. Par L. Joubin. *Map.*

France and Germany—Lorraine. *B.S.G. Marseille* **33** (1909–10): 305–342. **Rampal**
Lorraine française et Lorraine allemande. Esquisse Historique, Géographique et Économique. Par M. Auguste Rampal.

Germany—Bavaria. *Globus* **98** (1910): 38–40, 62–65. **Jaeger.**
Tölz und die Isarlandschaft. Von Julius Jaeger. *Sketch-map.*

Germany—Berlin. *B.S.G. Marseille* **33** (1909–10): 363–375. **Barré.**
Berlin: Principal centre de la circulation continentale en Europe. Traduit de la Woche, de Berlin. . . . Par M. Henri Barré.

Germany—Berlin—Climate. **Hellmann and others.**
Veröffentlichungen des K. Preussischen Meteorologischen Instituts, No. 221. Das Klima von Berlin. Von G. Hellmann. Unter Mitwirkung des Verfassers fortgeführt von G. v. Elsner und G. Schwalbe. II. Teil: Lufttemperatur. *Diagram.*

Germany—Magnetism. **Schmidt.**
Veröffentlichungen des K. Preussischen Meteorologischen Instituts, No. 217. Magnetische Karten von Norddeutschland für 1909 nach der von M. Eschenhagen und J. Edler in den Jahren 1898 bis 1903 ausgeführten magnetischen Landesaufnahme des Königl. Preuss. Meteorologischen Instituts bearbeitet von Ad. Schmidt. *Maps.*

Germany—Meteorology. **Süring and Mey.**
Veröffentlichungen des K. Preussischen Meteorologischen Instituts No. 218. Ueber den Zusammenhang zwischen Gewitterzügen und Niederschlagsgebieten. Von R. Süring und A. Mey. *Charts.*

Germany—Prussia—Sakrower See. **Schickendantz.**
Internat. Rev. Hydrobiologie u. Hydrographie **3** (1910): 84–92.
Temperaturen und Sauerstoff im Sakrower See bei Potsdam. Von Georg Schickendantz. *Diagrams.*

Holland—Survey. *Ts. K. Ned. Aardr. Genoots.* **27** (1910): 775–781. **Niermeyer.**
De nieuwe hoogtemeting in Nederland. Door J. F. Niermeyer.

Hungary—Hydrology. **Department of Water Administration.**
A Magyar állam jelentékenyebb folyóiban észlelt vízállások. VII.–XXIII. Köteket. A Dunában, Tiszában es mellékfolyóikban, a Balaton és Fertö tavakban s vízvidékeiken észlelt vízállások es csapadékok 1892–1908 években. [Observations of the water-levels of the chief rivers of Hungary. Vols. 7–23. The water-levels and precipitation in the basins of the Danube, Tisza, and their chief tributaries; and of the Balaton and Neusiedler Lakes, for the years 1892–1908.] Published by the Department of Water-Administration of the Royal Hungarian Ministry of Agriculture. Budapest, 1893–1909. Size $14\frac{1}{2} \times 10\frac{1}{4}$. *Index-maps and Diagrams. Presented by Dr. Lájos v. Lóczy.*

Hungary—Transylvania. *B.S. Hongroise G.* **38** (1910): 12–31. **Schilling.**
A Bodzaforduló. Irta Schilling Gábor. *Maps, Sections, and Illustrations.*

Italy—Sicily—Etna. **Starrabba.**

Atti R.A. Lincei, Rendiconti (*Sc. fisiche*) V. **19** (1910): 495–500.

L'eruzione etnea del 1910, dal 23 al 31 marzo. Del dott. Francesco Stella Starrabba. *Sketch-map.*

Italy—Venetia. *Riv. G. Italiana* **17** (1910): 89–94. **Revelli.**

Un nuovo scandaglio del Lago di Fimòn (Bèrici). Del Paolo Revelli. *Sketch-map.*

Jura. **Margerie.**

La structure du Jura. Par Emm. de Margerie. (Tirage à part, Actes de la Société Helvétique des Sciences Naturelles, 92me Session, Lausanne, 1909, T. i.) Basel, 1909. Size 9 × 6, pp. 30. *Presented by the Author.*

Portugal—Geology. **Dollfus and Cotter.**

Commission du Service géologique de Portugal. Mollusques tertiaires du Portugal. Le pliocene au Nord du Tage (Plaisancien). Par Gustave F. Dollfus et J. C. Berkeley Cotter. 1re partie. Lisbon, 1909. Size 13 × 10, pp. xxiv. and 104. *Illustrations and Sections. Presented by the Commission.*

United Kingdom—Hampshire. **Whitaker and others.**

Memoirs of the Geological Survey. England and Wales. The Water Supply of Hampshire (including the Isle of Wight), with records of Sinkings and Borings. By William Whitaker. With contributions by Dr. Hugh Robert Mill, W. Matthews, and Dr. J. C. Thresh. London, 1910. Size 9½ × 6, pp. 252. *Maps. Price 5s.*

United Kingdom—Meteorology. **Strachan.**

Basis of evaporation. Temperature of the sea around the British Islands. Notes on the climate of Ireland. By Richard Strachan. London: Williams & Strahan, 1910. Size 8½ × 5½, pp. 70. *Presented by the Author. Price 4s.*

United Kingdom—Scotland. *Scottish G. Mag.* **26** (1910): 183–191; 298–318. **Cossar.**

The Distribution of Towns and Villages in Scotland. By James Cossar.

ASIA.

Aden—Geology. *Records Geol. Surv. India* **38** (1910): 313–320. **Lloyd.**

The Geology of the Aden Hinterland. By Captain R. E. Lloyd. *Sketch-map and Illustrations.*

Asia—Historical. **Hedin.**

Svar på "tal." Af Sven Hedin. Stockholm: A. Bonnier, 1910. Size 9 × 6, pp. 64. *Facsimile maps. Presented by the Author.*

Various papers on the history of geographical knowledge of Central Asia and Siberia.

Asia—Orography. *Sc. Progress* **5** (1910): 38–47. **Oswald.**

Trans-Himalaya and Tibet. By Dr. Felix Oswald. *Sketch-map.*

Points out the similarity in structure between the Armenian and Tibetan plateaus.

China—Sechuan. **Legendre and Lemoine.**

Grandes lignes de la géologie du pays Lolo (Se-Tchouen, Chine). Par le Dr. A. F. Legendre et M. Paul Lemoine. (Extrait du *Bulletin du Muséum d'histoire naturelle*, No. 1, p. 59, 1910.) [Paris, 1910.] Size 9½ × 6½, pp. 4. *Map.*

China—Yunnan. **Brenier.**

Un livre anglais sur le Yun-nan et l'exploration français et la province. Par H. Brenier. (Extrait du *Bulletin de l'École française d'Extrême-Orient*, no. de janvier 1910.) Hanoi, 1910. Size 11 × 7½, pp. 30. *Presented by the Author.*

Includes, besides a review of Major Davies' work, notes on French surveys in Yunnan.

Eastern Asia—Phytogeography. *Sitzb. K. Preuss. A.W.* (1910): 1259–1281. **Engler.**

Die Bedeutung der Araceen für die pflanzengeographische Gliederung des tropischen und extratropischen Ostasiens. Von A. Engler.

India—Burma—Geology. *Records Geol. Surv. India* **38** (1910): 259–270. **Stuart.**

Geology and Prospects of Oil in Western Prome and Kama, Lower Burma (including Namayan, Padaung, Taungbogyi, and Ziaing). By Murray Stuart. *Sketch-map and Sections.*

India—Indus. *Geol. Mag.* V. 7 (1910): 289–290. **Hill.**
Erosion and Deposition by the Indus. By Arthur Hill.
Noticed in the Monthly Record (Vol. 36, p. 613).

Japan—Geological Survey. ——
Imperial Geological Survey of Japan, with a Catalogue of Articles exhibited at the Japan-British Exhibition held at London, England, in 1910. Tōkyō, 1910. Size 10 × 7, pp. 96. *Maps.* *Presented by the General Commissioner for Japan.*

Japan—Luchu Islands. *Travel and Exploration* 4 (1910): 81–88. **Clutterbuck.**
The Lu-chu Islands. By Walter J. Clutterbuck. *Illustrations.*

Japan—Population. *J.R. Statistical S.* 73 (1910): 738–768. **Takano.**
The Recent Movement of Population in Japan. By Prof. Iwasaburo Takano.

Malay Archipelago—Borneo. *Ts. K. Ned. Aardr. Genoots.* 27 (1910): 529–558. **Merens.**
De Bĕm Brĕm—stroomversnellingen. Door D. Merens. *Sketch-map and Illustrations.*

Malay Archipelago—Misol. *Ts. K. Ned. Aardr. Genoots.* 27 (1910): 469–500. **Wanner.**
Beiträge zur geologischen Kenntnis der Insel Misol (Niederländisch Ost-Indien). Von Dr. J. Wanner. *Maps and Illustrations.*

Malay Archipelago—Sumatra. **Hirschi.**
Ts. K. Ned. Aardr. Genoots. 27 (1910): 741–763.
Geographisch-geologische Skizze vom Nordrand von Sumatra. Von Dr. H. Hirschi *Maps and Illustrations.*

Malay Archipelago—Timor. **Rouffaer.**
Ts. K. Ned. Aardr. Genoots. 27 (1910): 794–796.
Aanteckeningen bij de schetskaart van Portugeesch-Timor. Door G. P. Rouffaer. *Map.*

Philippine Islands—Luzon—Geology. *Philippine J. Sc.* 5 (1910): A. 57–116. **Adams.**
Geologic Reconnaissance of South-Western Luzon. By George J. Adams. *Map, Illustrations, and Sections.*

Russia—Caucasus—Meteorology. ——
Beobachtungen des Tiflisser Physikalischen Observatoriums im Jahre 1899 (pp. 20); Ditto, 1900 (pp. 252); 1901 (pp. 169); 1902 (pp. 168); 1903 (pp. 170); 1904 (pp. 170). Tiflis, 1909. Size 13 × 9½.

Siam and Malay Peninsula—Railway. ——
B. Comité l'Asie Française 10 (1910): 338–340.
Le chemin de fer de Bangkok à la Malaisie Britannique. *Sketch-map.*

Turkey—Arabia—Hygiene. **Clemow.**
Étude sur la Défense sanitaire du Chemin de fer du Hedjaz. Par le Dr. F.-G. Clemow. (Extrait de la *Revue d'Hygiène et de Police sanitaire*, tome xxxii., Nos. 3 et 4, Mars et Avril 1910.) Paris, 1910. Size 9 × 6, pp. 54. *Sketch-map and Illustrations.* *Presented by the Author.*

AFRICA.

Abyssinia. *Riv. G. Italiana* 17 (1910): 169–180. **Mori.**
I confini e l'area dell' Impero Etiopico. Notizie storiche e determinazioni planimetriche di Attilio Mori. *Sketch-map.*

The area works out at 1,149,800 sq. km. (443,956 sq. miles) according to existing cartographical knowledge.

Abyssinia—Historical. **Beccari.**
Rerum Æthiopicarum Scriptores Occidentales inediti a sæculo xvi. ad xix., curante C. Beccari, s.J., vol. 10. Relationes et Epistolæ variorum. Pars Prima, Liber I. Rome: C. de Luigi, 1910. Size 10½ × 7½, pp. xviii. and 502. *Price* 20*s.* 8*d.*

Abyssinia—Historical. *B.S.G. Italiana* IV. 11 (1910): 607–624. **Revelli.**
Una relazione sull' "Abissinia" del 1578. Nota del Prof. Paolo Revelli. *Facsimile maps.*

The work here discussed ("Relazione dell' Africa . . . dettata da Giovanni Abissino e scritta da Piero Duodo") represents the earliest form of the fantastic relation of "Don Baldassare" (the "Juan de Baltasar" of the Spanish Dominican Urreta.)

Algerian Sahara—Jerid. *National G. Mag.* **21** (1910): 543–567. **Kearney.**
The Date Gardens of the Jerid. By Thomas H. Kearney. *Illustrations.*

Dahome. *La G., B.S.G. Paris* **21** (1910): 427–433. **Chevalier.**
Le pays des Hollis et les régions voisines. Par Aug. Chevalier.
The country of the Hollis, between the Weme and the Lagos frontier, has only lately been opened up.

Egypt—Ground-water. *Cairo Sc. J.* **4** (1910): 150–156. **Ferrar.**
On the Creation of an Artificial Water-table in Egypt. By H. T. Ferrar. *Diagrams.*
Mr. Ferrar thinks that the level of saturation has risen as a result of irrigation. Further discussions on the subject have since appeared in the same journal.

Egypt—Nile Valley. *Geol. Mag.* V. **7** (1910): 385–389. **Hume.**
The Origin of the Nile Valley in Egypt. By Dr. W. F. Hume.
Noticed in the Monthly Record, December, 1910, p. 731.

Egypt and Sudan—Climatology. *Quart. J.R. Met. S.* **36** (1910): 211–235. **Lyons.**
Climatic Influences in Egypt and the Eastern Sudan. By Captain H. G. Lyons. *Sketch-maps and Diagrams.*
See note in the Monthly Record (Vol. **36**, p. 614).

Egypt—Survey. **Survey Department.**
Ministry of Finance, Egypt, Survey Department. A Report on the Work of the Survey Department in 1909. Cairo, 1910. Size 10½ × 7, pp. 112. *Maps and Diagram. Presented by the Survey Department.*

French Equatorial Africa. *B.S.G. Marseille* **33** (1909–10): 376–382. **Mallet.**
Une Exploration de la rivière N'Goindé, affluent de la rive droite du Congo. Par M. E. Mallet. *Sketch-map.*
This river enters the Congo in 2° 20′ S.

French West Africa—Commercial. *B.S.G. Com. Paris* **32** (1910): 398–412. **Chudeau.**
Le grand commerce indigène de l'Afrique Occidentale. Par R. Chudeau. *Map.*

French West Africa—Niger Basin. *La G., B.S.G. Paris* **21** (1910): 389–408. **Chudeau.**
Le bassin du moyen Niger. Par R. Chudeau. *Sketch-map and Illustrations.*

French West Africa—Vegetation. *B.S.G. Com. Paris* **32** (1910): 361–397. **Chevalier.**
Les produits du règne végétal de l'Afrique Occidentale. Par Auguste Chevalier.

German South-West Africa. *Globus* **98** (1910): 1–7, 24–31. **Hutter.**
Im Gebiet der Etoshapfanne (Deutsch-Südwestafrika). Von Hauptmann a. D. Hutter. *Illustrations.*

German South-West Africa. *Deutsches Kolonialblatt* **21** (1910): 657–661. **Märcker.**
Am Naukluft-Gebirge. Aus einem Bericht des Majors Märcker.

German South-West Africa. *Globus* **98** (1910): 122–128, 133–137. **Seiner.**
Der Verbindungsweg zwischen Deutsch-Südwestafrika und der Betschuanenland-Eisenbahn. Von Franz Seiner. *Illustrations.*

German South-West Africa—Diamonds. **Wagner.**
T. Geol. S. South Africa **13** (1909–10): 56–60.
The Origin of the German South-West African Diamonds. By Percy A. Wagner. *Sketch-map.*
Noticed in the Monthly Record (Vol. **36**, p. 733).

German South-West Africa—Namaqualand. **Range.**
T. Geol. S. South Africa **13** (1909–10): 1–9.
Sketch of the Geology of German Namaqualand. By Paul Range. *Sections.*

Madagascar—Historical. **Grandidier and others.**
Collection des ouvrages anciens concernant Madagascar, publiée sous la direction de MM. A. Grandidier, Charles-Roux, Cl. Delhorbe, H. Froidevaux et G. Grandidier. Tome 7, Ouvrages ou extraits d'ouvrages français . . . (1604–1658). Par A. Grandidier, H. Froidevaux et G. Grandidier. Paris: Comité de Madagascar, 1910. Size 10 × 6½, pp. 472. *Price 25s.*

NORTH AMERICA.

Alaska—Glacial Erosion. *J. Geology* **18** (1910): 359–375. **Capps.**

Rock Glaciers in Alaska. By Stephen R. Capps. *Map and Illustrations.*

On a peculiar form of glacier formed of rock-fragments bound together by interstitial ice (See note in Vol. **36**, p. 615).

America—Mountaineering. **Fortescue.**

B. Bureau American Republics **30** (1910): 930–952.

The climbed and unclimbed peaks of the Americas. By Granville Fortescue. *Diagram and Illustrations.*

Canada—British Columbia. *National G. Mag.* **21** (1910): 457–487. **Palmer.**

Some tramps across the Glaciers and Snowfields of British Columbia. By Howard Palmer. *Illustrations.*

Canada—Glacial deposits. **Coleman.**

P. and T.R.S. Canada **3** (1909): Sect. IV., 3–12.

The Drift of Alberta and the Relations of the Cordilleran and Keewatin Ice Sheets. By A. P. Coleman.

Canada—Hudson bay. *P. and T.R.S. Canada* **3** (1909): Sect I., 3–36. **Prud'homme.**

La Baie d'Hudson. Par L. A. Prud'homme.

On the history of exploration around the bay.

Canada—Ice and water-power. **Murphy.**

P. and T.R.S. Canada **3** (1909): Sect. III., 143–177.

The Ice Question as it affects Canadian Water Powers. With a special reference to Frazil and Anchor Ice. By John Murphy. *Diagrams, Plans, and Illustrations.*

Canada—Mount Robson. *Appalachia* **12** (1910): 112–122. **Kinney.**

To the Top of Mount Robson, the Highest Peak in the Canadian Rockies. By George Kinney. *Illustrations.*

This ascent was made in 1909. Mr. Kinney was one of Prof. Coleman's party in the earlier attempt in 1907 (July number, 1910, p. 57).

Canada—New Brunswick. *P. and T.R.S. Canada* **3** (1909): Sect. IV., 45–65. **Bailey.**

The Geological Factors in the Present Configuration of New Brunswick. By L. W. Bailey. *Sketch-map.*

Canada—Resources. ———

Commission of Conservation, Canada. Report of the First Annual Meeting, held at Ottawa, January 18 to 21, 1910. Ottawa, 1910. Size 10 × 6½, pp. xvi. and 216. *Maps and Illustrations. Presented by the High Commisioner for Canada.*

Canada—Surveys. **Department of the Interior.**

Department of the Interior. Annual Report of the Topographical Surveys Branch, 1908–1909. Ottawa, 1910. Size 9½ × 6½, pp. vi. and 464. *Sketch-maps and Sections. Maps in separate cover.*

Labrador. *National G. Mag.* **21** (1910): 665–690. **Grenfell.**

A Land of Eternal Warring. By Sir Wilfrid T. Grenfell. *Illustrations.*

North America—Deserts. *National G. Mag.* **21** (1910): 691–714. **[MacDougal.]**

Notes on the Deserts of the United States and Mexico. [By Dr. Daniel T. MacDougal]. *Illustrations.*

North America—Erratics. *National G. Mag.* 21 (1910): 525–531. **Ljungstedt.**

The Erratic. By O. A. Ljungstedt. *Sketch-map and Illustrations.*

United States—Arizona—Meteor crater. **Magie.**

P. American Philosoph. S. **49** (1910): 41–48.

Physical Notes on Meteor Crater, Arizona. By William Francis Magie.

United States—California. **Arnold and Johnson.**

U.S. Geol. Surv. B. **406** (1910): pp. 226.

Preliminary Report on the McKittrick-Sunset Oil Region, Kern and San Luis Obispo Counties, California. By Ralph Arnold and Harry R. Johnson. *Maps and Section.*

United States—California. *U.S. Geol. Surv. B.* **398** (1910): pp. 354. **Arnold and others.**

Geology and Oil Resources of the Coalinga District, California. By Ralph Arnold and Robert Anderson. With a Report on the Chemical and Physical Properties of the Oils by Irving C. Allen. *Maps, Illustrations, and Sections.*

United States—California—Geology. *J. Geology* **18** (1910): 336–355. **Mendenhall.**
Notes on the Geology of Carrizo Mountain and Vicinity, San Diego County, California. By Walter C. Mendenhall. *Sketch-map, Sections, and Illustrations.*
This mountain lies south-south-west of the Salton sea.

United States—California—Irrigation. *National G. Mag.* **21** (1910): 568–596. **Heinly.**
Carrying water through a Desert. The story of the Los Angeles Aqueduct. By Burt A. Heinly. *Sketch-map and Illustrations.*

United States—California—Yosemite valley. *Appalachia* **12** (1910): 138–146. **Johnson.**
The Origin of the Yosemite Valley. By Douglas Wilson Johnson. *Illustrations and Sketch-maps.*

United States—Illinois. *J.G.* **8** (1910): 193–201. **Emerson.**
The Geographic Story of Kaskaskia. By F. V. Emerson. *Sketch-maps and Illustrations.*

United States—Ohio. **Carney.**
The Raised Beaches of the Berea, Cleveland, and Euclid Sheets, Ohio. By Frank Carney. (Reprinted from the *Bulletin of the Scientific Laboratories of Denison University*, vol. **14**, June, 1909.) N.P., 1909. Size 9½ × 6¼, pp. 262–287. *Sketch-map, Sections, and Illustrations.*

United States—Railways. *B. American G.S.* **42** (1910): 243–260. **Johnson.**
Sources of American Railway Freight Traffic. By Prof. Emory R. Johnson.

CENTRAL AND SOUTH AMERICA.

Andes—Nieves Penitentes. *Z. Gletscherkunde* **4** (1910): 343–350. **Reichert.**
Die Penitentesschneefelder in Gebiet zwischen Aconcagua und Tupungato. Von Dr. Fritz Reichert. *Illustrations.*
Dr. Reichert's explorations in this region were referred to in Vol. **36**, p. 496.

Argentine—Birds. **Dabbene.**
Ann. Museo Nacional, Buenos Aires, III. Ser. **11** (1910): pp. xlv. and 514.
Ornitologia Argentina. Catálogo Sistemático y Descriptivo de las Aves de la República Argentina, de las regiones limitrofes inmediates del Brazil, Paraguay, Bolivia, Chile y de los Archipielagos é islas al sur y sureste del continente americano hasta el circulo polar antartico. Tomo 1. Por Roberto Dabbene. *Map and Illustrations.*

Argentine—Jujuy—Archæology. **Debenedetti.**
Exploración Arqueológica en los Cementerios Prehistóricos de la Isla de Tilcara (Quebrada de Humahuaca, Provincia de Jujuy.) Campaña de 1908. Por el Dr. Salvador Debenedetti. (Universidad de Buenos Aires, Publicaciones de la Sección Antropológica, No. 6.) Buenos Aires, 1910. Size 11 × 7½, pp. 264. *Sketch-map and Illustrations.*

Argentine—Neuquen. *B.I.G. Argentino* **23** (1910): 177–199. **Kühn.**
Estudios geográficos de la vertiente oriental de la Cordillera argentina entre 39° y 41° Lat. Sur (Territorio Nacional de Neuquen). Por Franz Kühn. *Map and Illustrations.*

Bolivia—La Paz. **Crespo.**
Censo Municipal de la Ciudad de La Paz. (15 de Junio de 1909). Clasificaciones estadísticas, precedidas de una reseña geográfica-descriptiva-histórica de la Ciudad. Por Luis S. Crespo. La Paz, 1910. Size 11 × 7, pp. xiv. and 80. *Portraits and Illustrations.*

Brazil—Communications. *La G., B.S.G. Paris* **22** (1910): 23–40. **Anthouard.**
Les moyens de transport et de communication au Brésil. Par A. d'Anthouard.

Brazil—Historical. *Rev. I. Hist. e G. Brazileiro* **70** (1907): Pt. 2, 821–898. **Freitas.**
Relatorio do Dr. Norival Soares de Freitas, Commissionado do Instituto em Portugal. *Facsimile Maps.*
Report on documents preserved in Portugal bearing on Brazil.

Brazil—Maranhão. *B.G.S. Com. Paris* **32** (1910): 505–543. **Walle.**
L'état de Maranhao (Brésil). Par Paul Walle. *Sketch-map and Illustrations.*

Brazil—Putumayo. *Man* **10** (1910): 134–138. **Hardenburg.**
The Indians of the Putumayo, Upper Amazon. By W. E. Hardenburg.

Brazil—Seismology. *J. Geology* **18** (1910): 327–335. **Branner.**
Earthquakes in Brazil. By J. C. Branner. *Sketch-map.*
The author tabulates the comparatively few earthquakes known to have taken place in Brazil from 1744 onwards.

Costa Rica—Seismology. *National G. Mag.* **21** (1910): 494–525. **Pittier.**
Costa Rica—Vulcan's Smithy. By H. Pittier. *Sketch-maps and Illustrations.*

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El Volcán Poas. Apuntes por Modesto Martinez.

Dutch Guiana. *Ts. K. Ned. Aardr. Gen.* **27** (1910): 403–468, 641–701. **Eilerts de Haan.**
Verslag van de expeditie naar de Suriname River (30 Juin—20 November 1908). Door J. G. W. J. Eilerts de Haan. *Maps and Illustrations.*
See note *ante*, p. 96.

Guatemala. *National G. Mag.* **21** (1910): 596–624. **Tisdel.**
Guatemala, the Country of the Future. By Edine Frances Tisdel. *Sketch-map and Illustrations.*

Jamaica—Cayman Islands. ——
Report on the Cayman Islands (Jamaica). (Colonial Reports, Miscellaneous No. 73, 1910.) London, 1910. Size 9½ × 6, pp. 20. *Sketch-map and Plan.*

Patagonia—Ice age. *B. Geol. I. Univ. Upsala* **9** (1910): 60–92. **Quensel.**
On the influence of the Ice age on the continental watershed of Patagonia. By P. D. Quensel. *Maps, Sections, and Illustrations.*

AUSTRALASIA AND PACIFIC ISLANDS.

New Guinea—Dutch. [Herderschee.]
Ts. K. Ned. Aardr. Genoots. **27** (1910); 584–589, 812–817, 1031–1037.
Gouvernements-Exploratie van Ned. Nieuw Guinea. Noord Nieuw-Guinea. De Mamberamo Expeditie.
See note in the October number, 1910, p. 497.

New Guinea—Dutch. *Ts. K. Ned. Aardr. Genoots.* **27** (1910): 799–810. **Nouhuys.**
Een en ander over onzen tocht naar het Sneeuwgebergte van Ned. Indie. Door J. W. van Nouhuys. *Illustrations.*
See note in vol. **35**, p. 724.

New Zealand—Geology. *T. New Zealand I.* **42** (1909–10): 613–624. **Bell and Clarke.**
A Geological Reconnaissance of Northernmost New Zealand. By J. M. Bell and E. de C. Clarke. *Sketch-map and Illustrations.*

New Zealand—Raukumara. *New Zealand, Geol. Surv. B.* **9** (1910): pp. 48. **Adams.**
The Geology of the Whatatutu Subdivision, Raukumara Division, Poverty Bay. By James Henry Adams. *Maps and Illustrations.*

New Zealand—Wellington. *T. New Zealand I.* **42** (1909–10): 534–540. **Bell.**
The Physiography of Wellington Harbour. By J. M. Bell. *Map, Sections, and Illustrations.*

POLAR REGIONS.

Antarctic—Meteorology. *Scottish G. Mag.* **26** (1910): 407–417. **Mossman.**
Meteorology in the Weddell Quadrant during 1909. By R. C. Mossman. *Chart and Diagram.*

Arctic—Ice-sheet. *P. American Phil. S.* **49** (1910): 57–129. **Hobbs.**
Characteristics of the Inland Ice of the Arctic Regions. By William Herbert Hobbs. *Sketch-maps, Sections, and Illustrations.*

Greenland. *Z. Gletscherkunde* **4** (1910): 295–300. **Engell.**
Gletschermessungen in Grönland. Von M. C. Engell. *Sketch-map.*
A summary of observations and discussion of methods.

Polar Regions. *B.S.G. Italiana* IV. **11** (1910): 553–573. **Nordenskjöld.**
Le Terre antartiche e la natura polare. Del Prof. Otto Nordenskjöld. *Illustrations.*

Spitsbergen—Geology. *B. Geol. I. Univ. Upsala* **9** (1910): 41–59. **Högbom.**
Einige Illustrationen zu den geologischen Wirkungen des Frostes auf Spitzbergen. Von Bertil Högbom. *Illustrations.*

Spitsbergen—Geology. *B. Geol. I. Univ. Upsala* **10** (1910): 261–416. **Nathorst.**
Beiträge zur Geologie der Bären-Insel, Spitzbergens und des König-Karl-Landes. Von A. G. Nathorst. *Maps, Sections, and Illustrations.*

MATHEMATICAL GEOGRAPHY.

Determination of Position. *Ann. Hydrographie* **38** (1910): 171–175. **Kobbe.**
Ueber astronomische Ortsbestimmungen im Luftschiff. Von Oberstleut. v. Kobbe. *Diagrams.*

Survey—Instrument. *Ts. K. Ned. Aardr. Genoots.* **27** (1910): 781–786. **Ferguson.**
De meridiaan-wijzer. Een eenvoudig toestel voor de direkte bepaling van den waren meridiaan, het azimuth, de Kompasvariatie, enz. Door Thos. Ferguson. *Illustration.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Age of the Earth. *Smithsonian Misc. Coll.* **56** (1910): No. 6, pp. 28. **Becker.**
The Age of the Earth. By George F. Becker.

Climatology. *Sitzb. K. Preuss. A. W.* (1910): 236–246. **Penck.**
Versuch einer Klimaklassifikation auf physiogeographischer Grundlage. Von Albrecht Penck.

Climatology. *G.Z.* **16** (1910): 261–272, 318–327. **Thorbecke.**
Das ozeanisch-subtropische Klima und die Gebiete der Etesien und Winterregen. Von F. Thorbecke.

Denudation. *Smithsonian Misc. Coll.* **56** (1910): No. 5, pp. 20. **Clarke.**
A Preliminary Study of Chemical Denudation. By Frank Wigglesworth Clarke.
Noticed in the Monthly Record (Vol. **36**, p. 618).

Earth-movements. **Lallemand.**
La Respiration de la Terre. L'Écorce terrestre. Ses mouvements rythmés et ses déformations permanentes. Par Ch. Lallemand. (Extrait de la Revue Scientifique du 28 août 1909.) Paris, 1909. Size 9 × 5½, pp. 40. *Plans, Diagrams, and Illustrations. Presented by the Author.*

Geomorphology. *B.S.G. Lyon* 2 Ser. **3** (1910): 1–16. ———
Atlas photographique des formes du relief terrestre. Choix de documents Morphologiques caracteristiques accompagnés de Notices Scientifiques. Première circulaire du Comité désigné pour en assurer l'exécution par le IX^e^ Congrès International de Géographie.

Geomorphology—Coasts. *Ts. K. Ned. Aardr. Genoots.* **27** (1910): 768–774. **Balen.**
Over de vorming van strandwallen en hoogveen. Door C. L. van Balen.

Geomorphology—Deserts. **Penck.**
Verhandl. XVII. Deuts. G.-tages, Lübeck 1909 (1910): 125–140.
Die Morphologie der Wüsten. Von Prof. Dr. Albrecht Penck.

Geomorphology—Dunes. *Ts. K. Ned. Aardr. Genoots.* **27** (1910): 395–402. **Dubois.**
Over duinvalleien, den vorm der Nederlandsche kustlijn en het ontstaan van laagveen in verband met bodembewegingen. Door Eug. Dubois.

Geomorphology—Karst. *G.Z.* **16** (1910): 134–142. **Krebs.**
Offene Fragen der Karstkunde. Von Norbert Krebs.

Geomorphology—Wind-erosion. *Geol. Mag.* V. **7** (1910): 394–398. **Wade.**
On the Formation of Dreikante in Desert Regions. By A. Wade. *Illustrations.*
"Dreikante" are stones shaped like a Brazil nut, resulting from wind-erosion.

Geophysics. *Sitzb. K. Preuss. A. W.* 1909: 1192–1198. **Helmert.**
Die Tiefe der Ausgleichsfläche bei der der Prattschen Hypothese für das Gleichgewicht der Erdkruste und der Verlauf der Schwerestörung vom Innern der Kontinente und Ozeane nach den Küsten. Von F. R. Helmert.

Geophysics—Internal heat. *P.R.S.* Ser. A. **83** (1910): 339–346. **Lees.**
On the Shapes of the Isogeotherms under Mountain Ranges in Radio-active Districts. By Dr. Charles H. Lees. *Diagrams.* [See note *ante*, p. 99.]

Glaciers. *Z. Gletscherkunde* **4** (1910): 374–380. **Romer.**
Ueber eine einfache Methode der Höhenbestimmungen der Gletscherenden. Von Prof. E. Romer.

Gravity. *Riv. G. Italiana* **17** (1910); 1–46. **Bianco.**
La gravità alla superficie del mare e l'ipotesi di Pratt. Dell Ottavio Zanatti Bianco.

Gravity. *B. American G.S.* **42** (1910): 358–362. **Littlehales.**
The Measurement of the Intensity of Gravity on the Ocean and its Significance. By G. W. Littlehales.

Hydrology. **Meinardus.**
Prof. Dr. Wilh. Meinardus: Ueber den Kreislauf des Wassers. (Sonderabdruck aus den Sitzungsberichten der Medizinisch-Naturwissenschaftlichen Ges. zu Münster i. W., 1908.) Size 8½ × 5½, pp. 8.

Ice. *P. and T.R. S. Canada* **3** (1909): Sect. III., 3–27. **Barnes.**
The Physical Constants of Ice. By Prof. Howard T. Barnes.

Landslides. *National G. Mag.* **21** (1910): 277–287. **Mitchell.**
Landslides and Rock Avalanches. By Guy Elliott Mitchell. *Illustrations.*

Limnology—Plankton. **Wesenberg-Lund.**
Internat. Rev. Hydrobiologie u. Hydrographie **3** (1910): *Biol. Suppl.* (*First paper*), pp. 44.
Grundzüge der Biologie und Geographie des Süsswasserplanktons nebst Bemerkungen über Hauptprobleme zukünftiger limnologischen Forschungen. (Mitteilungen aus dem biologischen Süsswasserlaboratorium Frederiksdal bei Lyngby, Dänemark, Nr. 6.) Von Dr. Wesenberg-Lund. *Illustrations.*

Magnetism. *Terrestrial Magnetism* **15** (1910): 57–82. **Bauer and Peters.**
The Complete Magnetic Results of the First Cruise of the *Carnegie*, 1909–10. By L. A. Bauer and W. J. Peters. *Illustration and Section.*

Meteorology. *Smithsonian Misc. Coll.* **51**, No. 4 (1910): pp. 618. **Abbe and others.**
The Mechanics of the Earth's Atmosphere. A collection of Translations by Cleveland Abbe. Third Collection. *Diagrams.*

Meteorology. **Craig.**
Humidity and Evaporation. By J. J. Craig. Alexandria, 1909. Size 10½ × 7, pp. 4. *Diagram.*

Meteorology—Evaporation. *Ann. Hydrographie* **38** (1910): 267–271. **Lütgens.**
Weitere Untersuchungen über die Verdunstung auf dem Meere. Von Dr. Rudolf Lütgens.

Meteorology—North Atlantic. *Quart. J.R. Met. S.* 36 (1910): 197–210. **Rawson.**
The North Atlantic Anticyclone: Tracks of the Centres of High Areas, 1882–1883. By Colonel H. E. Rawson. *Sketch-maps.*

Meteorology—Trade-winds. **Hepworth and others.**
Meteorological Office. The Trade-winds of the Atlantic Ocean. Contributions to the study of the North-East and South-East Trade-winds, comprising a comparison of the changes in the temperature of the water of the North Atlantic and in the strength of the Trade-winds. By M. W. Campbell Hepworth. Climatological tables for St. Helena, with a report upon the records of the Robinson Anemograph, from 1892 to 1907, by John Somers Dines; and note on the connection between the periodic variations of wind-velocity and of atmospheric pressure, by Ernest Gold. London: Wyman & Sons, 1910. Size 12 × 9½, pp. xii. and 46. *Charts, Diagrams, and Illustrations. Price* 3*s.*

Oceanography—Currents. **Krümmel.**
Verhandl. XVII. Deuts. G.-tages, Lübeck, 1909 (1910): 75–90.
Ein Blick auf die neueren Theorie der Meeresströmungen. Von Prof. Dr. O. Krümmel.

Oceanography—Pacific Ocean. *Ann. Hydrographie* **38** (1910): 98–103. **Trotha.**
Tiefseelotungen S.M.S. *Planet* 1909 unter dem Kommando von Korvettenkapitän v. Trotha. *Charts.*

Seismology. **Klotz.**
Earthquake Epicentres. By Dr. Otto Klotz. (Reprinted from the *Journal of the Royal Astronomical Society of Canada*, May–June, 1910.) [Ottawa, 1910.] Size 9½ × 6½, pp. 6. *Diagrams. Presented by the Author.*

Seismology. **Klotz.**

The Seismograph. By Dr. Otto Klotz. (Reprinted from the *Journal of the Royal Astronomical Society of Canada*, March-April, 1910.) [Toronto, 1910.] Size 9½ × 6½, pp. 116–129. *Diagrams. Presented by the Author.*

Seismology. *B. Imp. Earthquake Investigation Com.* **4** (1910): 1–31. **Omori.**

Seismic Experiments on the Fracturing and Overturning of Columns. Second Paper. By Dr. F. Omori. *Diagrams and Sections.*

Seismology. *Beiträge Geophysik* **10** (1910): 318–351. **Reid.**

On mass movements in tectonic earthquakes and the depth of the focus. By Harry Fielding Reid. *Sketch-map and Diagrams.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Anthropology. *Sc. Progress* **5** (1910): 126–146. **Ridgeway.**

'Prof. Ridgeway and Racial Origins': A Reply. By Prof. William Ridgeway.

A reply to criticisms by Mr. B. Houghton.

Commercial. *B. American G.S.* **42** (1910): 346–355. **Smith.**

The Development of Commercial Centers. By J. Russell Smith.

Noticed in the October number.

Commercial. *Scottish G. Mag.* **26** (1910): 169–182. **Chisholm.**

The Geographical Relation of the Market to the Seats of Industry. By George G. Chisholm.

Commercial—Ports. *L'Esplorazione Com.* **25** (1910): 205–213. **Michieli.**

Su la sfera d'influenza dei Porti e le carte destinate a rappresentarla. Note preliminari di Adr. Augusto Michieli.

History of Cartography. *Mem. G., Ric. G. Italiana* **3** (1909): 113–188. **Magnaghi.**

Contributi alla storia della cartografia d'Italia. II. Sulle origini del Portolano normale nel medio Evo e della Cartografia dell' Europa occidentale. Di Alberto Magnaghi.

Historical Geography. *B.R.S.G. Madrid* **52** (1910): 145–179. **Fournier.**

Necesidad de una reconstrucción historica y geográfica de pueblos, de razas y de civilizaciones antiguas. Par Sr. D. Gervasio Fournier. *Sketch-maps.*

Has special reference to Spain.

History of Geography. *B.S.G. Italiana*, IV. **11** (1910): 843–852. **Zippel.**

Cosmografi al servizio dei Papi nel Quattrocento. Nota del prof. Giuseppe Zippel.

BIOGRAPHY.

Cary. **Fordham.**

John Cary, Engraver and Map-seller (fl. 1769–1836). A Paper read at a Meeting of the Cambridge Antiquarian Society, December 6, 1909. By Sir Herbert George Fordham. Cambridge, 1910. Size 8½ × 5½, pp. 8. *Presented by the Author.*

See note in Vol. 36, p. 500.

GENERAL.

British Empire—Historical. **Forbes.**

A history of the British Dominions beyond the seas (1588–1910). Edited by Avary H. Forbes. London: Ralph, Holland & Co., [1910]. Size 7½ × 5, pp. 240. *Sketch-maps. Price 2s. 6d. net. Presented by the Publishers.*

Education—Text-Book. **Reynolds.**

Elementary regional geography. Great Britain and Ireland. By J. B. Reynolds. London: A. & C. Black, 1910. Size 7 × 4½, pp. viii. and 184. *Sketch-maps and Illustrations. Price 1s. 4d. Presented by the Publishers.*

Geography. **Ghisleri.**

Prof. A. Ghisleri. Per la geografia nella scuola e nella vita. Scritti varii (1893–1908). Bergamo: Istituto Italiano d'Arti Grafiche, [1910]. Size 9½ × 6½, pp. 90. *Presented by the Author.*

OLDER WORKS ADDED TO THE LIBRARY DURING 1910.

Abderrahman ben Abdallah ben 'Imran ben 'Amir es-Sa'di.—Tarikh es-Soudan. (Documents arabes relatifs à l'histoire du Soudan.) Texte arabe et traduction édité par O. Houdas. 2 vols. (Publications de l'Ecole des Langues Orientales Vivantes, IV^e^ Serie, vols. 12-13.) Size 11 × 7. *Paris*, 1898-1900.

Akhbar Molouk es-Soudân.—Tedzkiret en-Nisiân. (Documents arabes relatifs à l'histoire du Soudan.) Texte arabe et traduction française édité par O. Houdas. 2 vols. (Publications de l'Ecole des Langues Orientales Vivantes, IV^e^ Série, vols. 19-20). Size 11 × 7. *Paris*, 1899-1901.

Cawston, George, and A. H. Keane.—The early Chartered Companies (A.D. 1296-1858). *Illustration.* Size 8½ × 5½. *Presented by George Cawston, Esq.* *London*, 1896.

Delafosse, Maurice.—Essai de manuel pratique de la langue mandé ou mandingue. Etude grammaticale du dialecte dyoula; vocabulaire Français-Dyoula: histoire de Samori en Mandé; étude comparée des principaux dialectes mandé. (Publications de l'Ecole des Langues Orientales Vivantes, III^e^ Série, vol. 14.) Size 11 × 7. *Paris*, 1901.

Des Michels, Abel.—Chih louh kouoh kiang yuh tchí. Histoire géographique des seize royaumes. Ouvrage traduit du Chinois [de Hông-liáng-kâli] pour la première fois et annoté. Fascicules 1-2. (Publications de l'Ecole des Langues Orientales Vivantes, III^e^ Série, tome 11.) Size 11 × 7. *Paris*, 1891-92.

Grandidier, Alfred.—Histoire physique, naturelle, et politique de Madagascar. Vol. 1. Histoire de la géographie: Atlas. 47 *plates* (*in* 67) *of facsimile Maps.* Size 13 × 10. *Presented by the Author.* *Paris*, 1889-92.

McClure, Admiral Sir Robert.—The private journal of R. J. Le M. McClure of the voyage of discovery on board H.M.S. *Terror*, under the command of Captain George Back, in search of a North-West Passage. Commencing June, 1836, and ending September, 1837. Size 12½ × 8. *Illustration.* *MS.*

McClure, Admiral Sir Robert.—[Official Letter and Order Book of, Despatches to the Admiralty from, and Journal of H.M.S. *Investigator*, Robert McClure commanding, in search of Sir John Franklin. December, 1849 to April, 1853.] 3 vols. Size 12½ × 8. *MS.*

Mackesy, William H.—Table of barometrical heights to 20,000 feet, specially adapted for the use of Officers on service, Civil Engineers, and Travellers in India. Size 3 × 5. *Presented by the Author.* *London*, 1882.

Mohammed Nerchakhy.—Description topographique et historique de Boukhara, suivie de textes relatifs à la Transoxiane. Teste persan, publié par Charles Schefer. (Publications de l'Ecole des Langues Orientales Vivantes, III^e^ Serie, vol. 13.) Size 11 × 7. *Paris*, 1892.

Neumayer, Dr. G. (Editor).—Die internationale Polarforschung, 1882-1883. Die deutschen Expeditionen und ihre Ergebnisse; Bd. II: Beschreibende Naturwissenschaften in einzelnen Abhandlungen, herausgegeben im Auftrage der Deutschen Polar-Kommission. *Illustrations.* Size 10 × 6½. *Berlin*, [1889].

Rainsford, Marcus.—An historical account of the black empire of Hayti: comprehending a view of the principal transactions in the revolution of Saint Domingo, with its antient and modern state. *London*, 1805.

Rawlinson, George.—The Sixth Great Oriental Monarchy; or, the geography, history, and antiquities of Parthia. *Maps and Illustrations.* Size 9 × 5½. *London*, 1873.

Sanchez, Zacarias.—Notas descriptivas de la provincia de Corrientes, complementarias de la Carta Geografica. Con un registro general de las propriedades rurales Size 9½ × 6½. *Presented by W. S. Barclay, Esq.* *Buenos Aires*, 1894.

Smirnov, Jean N.—Les populations finnoises des bassins de la Volga et de la Kama. Etudes d'ethnographie historique, traduites du Russe et revues par Paul Boyer. 1^re^ partie. (Publications de l'Ecole des Langues Orientales Vivantes, IV^e^ Série, vol. 8.) Size 11 × 7. *Paris*, 1898.

[Zurlauben, Baron Béat-Fidèle-Antoine-Jean-Dominique].—Tableaux de la Suisse, ou voyage pittoresque fait dans les xiii. cantons du Corps Helvétique, représentant les divers phénomènes que la Nature y rassemble, et les beautés dont l'Art les a enrichis. Séconde édition. 12 vols. *Maps and Illustrations.* Size 10½ × 8. *Paris*, 1784-86.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Denmark.

Politiken Danmark i 35 Kort med 3 Kort over nordslesvig. Copenhagen: "Politikens" Forlag, 1910.

A small pocket atlas of Denmark, consisting of 35 coloured maps on the scale of 1:260,000, Bornholm in 3 sheets on 1:130,000, and North Schleswig in 3 sheets on 1:300,000. There is also a good index to place-names.

British Isles—England. **Stackhouse.**

Geologically coloured relief model of North Cleveland, Yorkshire. By J. Foster Stackhouse. Scale 1:10,560 or 6 inches to 1 stat. mile. Middlesbrough and Newcastle-on-Tyne: The Geographical Model Works, 1910. *Price, geologically coloured*, 50*s.*; *uncoloured*, 20*s.* *Presented by J. Foster Stackhouse, Esq.*

The area included in this model is that covered by Sheets VIII. N.W. and S.W. and VIII. S.E. of the 6-inch Ordnance Survey of Yorkshire, which extend from about half a mile west of Saltburn-by-the-Sea, along the coast to nearly 2 miles east of Skinningrove. The horizontal and vertical scale are the same, so that the true relief can be seen at a glance. The construction has been most carefully carried out by Mr. Stackhouse, and the copy presented to the Society is geologically coloured according to the 6-inch sheets of the Geological Survey. Casts of the model, which measures about 1 foot × 3 feet, can be obtained of the Geographical Model Works, Middlesbrough, at the prices mentioned above.

British Isles—England and Wales. **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from November 1 to 31, 1910.

1-inch (third edition, engraved in outline):—
England and Wales. Sheets 163, 229. *Price* 1*s. each.*
Ditto. Hills in black or brown. Sheets 163, 173, 193. *Price* 1*s. each.*

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Hampshire, 18 sheets. **Lancashire**, 1 sheet. **Lincolnshire**, 2 sheets. **Sussex**, 4 sheets. **Yorkshire**, 3 sheets. *Price* 1*s. each.*

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New Series, colour printed. Drift Edition. Sheet 155. *Price* 1*s.* 6*d.*
Nottingham District map. Parts of sheets 125, 126, 141, 142. *Price* 1*s.* 6*d.*
(*E. Stanford, London Agent.*)

France. **Bartholomew.**

Bartholomew's Contour Motoring Map of France and Portions of Adjoining Countries, showing all the principal roads, with heights and distances in metres and kilometres. Scale 1:1,000,000 or 1 inch to 15·8 stat. miles. 2 sheets. Edinburgh: John Bartholomew & Co., [1910]. *Price, dissected and mounted on cloth and folded in thumb case*, 10*s.* 6*d. net. Presented by the Publishers.*

This map should be very useful to motorists and tourists. It is specially clear, and shows elevation of land by tints of green and brown. Roads are shown in red double and single lines, which are arranged so as to indicate their character. The distances in kilometres between junctions of roads and places on the roads are given. The map is in two sheets, and measures 43 by 44 inches, but is mounted to fold conveniently for the pocket.

Germany—Prussia. **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Königreich Preussen. Herausgegeben von der Kartogr. Abteilung der Königl. Preuss. Landesaufnahme. Scale 1:100,000 or 1 inch to 1·6 stat. mile. Sheets: 504, Cochem; 524, Bernkastel; 555, St. Wendel. Berlin: R. Eisenschmidt, 1909–10. *Price* 1.50*m. each sheet.*

Germany. **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Herausgegeben von der Kartogr. Abteilung der Königl. Preuss. Landesaufnahme Kupferdruck-Ausgabe. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets : 28, Kumehnen ; 52, Insterburg ; 487, Schlüchtern ; 588, Rastatt. Berlin : R. Eisenschmidt, 1910. *Price* 1.50*m. each sheet.*

Germany—Saxony. **K. Sächs. Generalstabes.**

Karte des Deutschen Reiches. Königreich Sachsen. Herausgegeben von der Abteilung für Landesaufnahme des Königl. Sächs. Generalstabes. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets : 471, Fürstenau. Dresden : G. A. Kaufmann, 1909. *Price* 1.50*m. each sheet.*

ASIA.

Asia Minor. **Endriss.**

Durchquerungen der Bithynischen Halbinsel von Dr. [W.] Endriss. Mit den älteren Aufnahmen als geologische Übersicht vereinigt. Scale 1 : 300,000 or 1 inch to 4·7 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1910, II., Tafel 31. Gotha : Justus Perthes, 1910. *Presented by the Publisher.*

China. **Geographical Section, General Staff.**

Map of China, showing Railways, Telegraphs, and Treaty Ports. Compiled in the Geographical Section, General Staff. Scale 1 : 5,000,000 or 1 inch to 78·9 stat. miles. London : Edward Stanford, Sifton Praed & Co., and Fisher Unwin, 1910. *Price* 1*s.* 6*d. net.*

Japan. **Imperial Geological Survey, Tokyo.**

Geological map of the Japanese Empire with Corean Peninsula. Scale 1 : 2,000,000 or 1 inch to 31·5 stat. miles. 4 sheets. Tokyo : Imperial Geological Survey, 1910. *Presented by the Director, Imperial Geological Survey, Tokyo.*

An excellent general geological map of the whole Empire, from the surveys of Imperial Geological Survey of Japan. The lettering and explanation of the geological colouring is given in English as well as Japanese, so that the map will be useful to geologists in this country, specially as it is on a sufficiently large scale to admit of considerable detail.

Persia. **Johnston.**

Persia and Afghanistan. Scale 1 : 4,311,000 or 1 inch to 68 stat. miles. Edinburgh and London : W. & A. K. Johnston, Ltd., 1910. *Price* 3*s. Presented by the Publisher.*

Sumatra. **Topographical Bureau, Batavia.**

Overzichtskaart van het eiland Sumatra. Scale 1 : 2,000,000 or 1 inch to 31·5 stat. miles. Batavia : Topographische Inrichting, 1910.

AFRICA.

Belgian Congo. **Falk Fils.**

Carte du Congo Belge. Scale 1 : 4,000,000 or 1 inch to 63·1 stat. miles. Brussels : Falk Fils, 1910.

AMERICA.

Canada. **Comer.**

Kapt. G. Comers Aufnahme der Southampton-Insel im Eingang zur Hudson-Bucht. Scale 1 : 2,000,000 or 1 inch to 31·5 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1910, II., Tafel 36. Gotha : Justus Perthes, 1910.

Canada. **Department of the Interior, Ottawa.**

Cereal map of Manitoba, Saskatchewan, and Alberta, showing acreage under crop in each Township in wheat, oats, barley, and flax. Scale 1 : 792,000 or 1 inch to 12·5 stat. miles. Preliminary edition. Ottawa : Department of the Interior, 1909. *Presented by the Department of the Interior, Ottawa.*

Most important and instructive for all interested in grain cultivation in the provinces of the Dominion of Canada concerned. It consists of a large outline map with railways measuring 38 inches by 77 inches, upon which is shown, by numerous circular symbols of various sizes, the area in acres of grain under cultivation in each township, the character of grain being distinguished by different colours. The compilation of this information alone must have entailed a vast amount of labour, but the map gives in addition numerous statistical tables dealing with the same subject, of which the most extensive is that showing the capacity of grain elevators in these provinces.

Canada. **Department of the Interior, Ottawa.**

Sectional map of Canada. Scale 1 : 190,080 or 1 inch to 3 stat. miles. Sheets: 162, Seymour, revised to August 16, 1910; 168, The Elbow, revised to September 3, 1910; 317, Fort Pitt, revised to August 30, 1910; 364, Fort Assiniboine, revised to August 17, 1910. Ottawa: Department of the Interior, Topographical Surveys Branch, 1910. *Presented by the Department of the Interior, Ottawa.*

Central America. **Vischer.**

Mapa de América Central. Por Alfredo Vischer. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. 4 sheets. Berlin: Dietrich Reimer (Ernst Vohsen), 1910.

Maps of Central America of a recent date are by no means plentiful, so that the above, although decidedly rough and diagrammatic in appearance, is important. An attempt has been made to show relief by tints of green and brown, combined with hill shading. A plan and two sections of the Panama canal now under construction are given in an inset.

Mexico. **Molina.**

Carta General de la Republica Mexicana. Formada en la Secretaria de Fomento por disposicion del Secretario del Ramo, Lic. Olegario Molina. Scale 1 : 2,000,000 or 1 inch to 31·6 stat. miles. 4 sheets. Mexico: Sección de Reproducciones de la Comisión Geografico-Exploradora, 1910.

A useful general map of Mexico in four sheets. Relief is lightly indicated by brown shading, railways and roads are clearly shown, and a table of the positions in latitude and longitude of the principal places is given on the south-east sheet.

United States. **U.S. Geological Survey.**

Geologic Atlas of the United States. Folios: 160, Accident—Grantsville, Maryland—Pennsylvania—West Virginia; 161, Franklin Furnace, New Jersey; 162, Philadelphia, Pennsylvania—New Jersey—Delaware; 163, Santa Cruz, California; 164, Belle Fourche, South Dakota; 165, Aberdeen—Redfield, South Dakota; 166, El Paso, Texas; 167, Trenton, New Jersey—Pennsylvania; 168, Jamestown—Tower, North Dakota; 169, Watkins Glen—Catatonk, New York; 170, Mercersburg—Chambersburg, Pennsylvania; 171, Engineer Mountain, Colorado; 172, Warren, Pennsylvania—New York; 173, Laramie—Sherman, Wyoming. Washington: Department of the Interior, U.S. Geological Survey, 1908-1910. *Presented by the Director, U.S. Geological Survey.*

PACIFIC OCEAN.

German New Guinea. **Friederici and Sapper.**

Reise von Eitapé längs der Küste nach Hollandia (Westlichster Teil der Nordküste von Kaiser Wilhelmsland, Deutsch Neuguinea). Aufgenommen von Hauptmann a. D. Dr. G. Friederici, Dezember 1909, gezeichnet von Prof. Dr. K. Sapper. Scale 1 : 300,000 or 1 inch to 4·7 stat. miles.—Reise in das Hinterland von Eitapé (Nordküste von Kaiser Wilhelmsland, Deutsch Neuguinea). Aufgenommen von Hauptmann a. D. Dr. G. Friederici, Dezember 1909, gezeichnet von Prof. Dr. K. Sapper. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. *Petermanns Mitteilungen*, Jahrang 1910, II., Tafeln 34 u. 35. Gotha: Justus Perthes, 1910. *Presented by the Publisher.*

GENERAL.

French Colonies. **Pelet.**

Atlas des Colonies Françaises. Par Paul Pelet. Sheet 3, Algerie. I., Dept. d'Oran. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. Paris: Armand Colin & Cie., 1910.

World. **Bartholomew.**

Bartholomew's Chart of the World on Mercator's Projection. Equatorial scale 1 : 25,000,000 or 1 inch to 394·5 stat. miles. Edinburgh: John Bartholomew & Co., 1910. *Price* £1 1*s. net. Presented by the Publishers.*

A new and revised edition of this useful wall chart. It gives much information, not only concerning boundaries of countries, positions of places, railways, canals, and other subjects of the kind on land, but on the oceans shows ocean currents, steamer tracks, cables, and soundings; so that generally the chart should be most useful for offices and libraries, upon the walls of which it is specially intended that it should find a place. It is in no sense a school wall map to be seen at a distance, and requires close inspection, as the details and names are small. It can be obtained mounted and folded in a case, if desired.

World. **Johnston.**

Bathy-orographical Map of the World in Gall's (stereographic) projection. Equatorial scale 1 : 33,634,000 or 1 inch to 530·8 stat. miles. Edinburgh and London: W. & A. K. Johnston, Ltd., [1910]. *Price, mounted on rollers and varnished,* 12*s*. *Presented by the Publishers.*

A general wall map of the world, showing heights of land and ocean depths by colour tinting. The lower lands are green, and higher in two shades of brown. It is difficult to understand why Gall's so called "stereographic" projection has been selected, since the distortion in the high latitudes is very great. Mercator's projection of course exaggerates dimensions of land areas tremendously in the direction of the poles, still the correct land forms of limited areas are more or less preserved, while on this in high latitudes, they are so extended to the east and west as to be almost beyond recognition. Insets are given on Mollweide's elliptical equal-area projection, showing mean annual temperature and rainfall. The map is mounted on rollers and varnished.

World. **Philip.**

Philip's Pictorial Pocket Atlas and Gazetteer. One hundred and forty-eight pages of maps, pictures, and statistical diagrams, with gazetteer-index of 18,000 names. London: George Philip & Son, Ltd., [1910]. *Price* 1*s*. *net. Presented by the Publishers.*

A small and remarkably cheap little pocket atlas. To commence with, there is a set of physical maps, in which it is attempted to show relief much as it would appear in photographs of raised models, but which, though graphic, are not very reliable, and facing each of these is a plate of illustrations typical of the country shown on the map. After these follow astronomical diagrams, maps of the world showing climate, vegetation, population, languages; then maps of the North and South Poles, and eighty-eight plates of ordinary general maps of all parts of the world. Finally comes what perhaps is the most interesting of all the contents, a set of graphic statistical diagrams, giving at a glance, by various pictorial devices, a good idea of the national revenue of the world, imports and exports of the United Kingdom, commerce of the British colonies, and the shipping, railways, armies, and products of various nations. There is at the end a useful gazetteer.

World. **St. Martin and Schrader.**

Atlas Universel de Geographie construit d'après les sources originales et les documents les plus récents, cartes, voyages, mémoires, travaux géodesiques, etc. Avec une texte analytique. Ouvrage commencé par M. Vivien de Saint Martin et continué par Fr. Schrader. Carte No. 62, Maroc. Paris: Hachette & Cie., 1910. *Presented by the Publishers.*

As is the case with the previous maps of this atlas, there is an accompanying sheet of letterpress stating the authorities from which it has been compiled. As a specimen of engraving the map is excellent, and the printing is not so dark as is the case with many of the other sheets, although there is still room for improvement in this respect.

World. **Schrader.**

L'Année Cartographique, Vingtième Année. Supplement annuel à toutes les publications de Geographie et de Cartographie. Dressé et rédigé sous la direction de F. Schrader. Paris: Hachette & Cie., 1910. *Price* 3 *fr. Presented by the Publishers.*

The twentieth year of issue of this useful publication includes a brief review on the principal geographical events of the year 1909. It consists, as usual, of three sheets of maps showing new surveys and explorations, boundaries delimited, etc., during the year, with notes on the back of each. The first sheet deals with Asia, the second with Africa, and the third with America and the Polar Regions. An important additional note on a separate slip is given with the Asia sheet, correcting statements concerning the amount of survey work of the expedition of Commandant de Lacsote, which it would be well to fix to that sheet. This part contains much that will be useful for ready reference. There are one or two slight errors that might be pointed out; for instance, it is a mistake to show Commander Peary's route to the North Pole as deviating to the north-east to the explorer's furthest north point of 1906, since he followed as near as possible the Cape Columbia meridian direct to the pole.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during October, 1910. *Presented by the Hydrographer, Admiralty.*

New Charts—No. 2469, Germany: The Kaiser Wilhelm canal, 2*s*. 1938, Baltic,

Little Belt: Alsen sund and Augustenburger fiord, 3*s*. 646, Africa, east coast: Lourenço Marques, 3*s*. 3161, Borneo, south coast: Tanjong Malatayur to Tanjong Puting, 4*s*. **New Plans and Plans added**—No. 2166, Bay of Bengal, Mergui archipelago. Plan added: Pak chan river, Renong anchorage, 3*s*. 1143, Malacca strait, Anchorages in. Plan added: Muar river, 1*s*. 1730, Samoa islands. Plan added: Sili road, 3*s*. **New Editions**—No. X.11, Signs and abbreviations on Admiralty charts, 2*s*. 1652, England, south coast: Owers to Beachy head, 4*s*. 2045, England, south coast: Owers to Christchurch, 5*s*. 1613, England, south coast: Bigbury bay to Exmouth, 3*s*. 1951, England, west coast: Liverpool bay, 3*s*. 1170*b*, England, west coast: Great Ormes head to Liverpool, 3*s*. 3667, Baltic: Nidingen to Tylö, 3*s*. 2250, Baltic: Gotland, 3*s*. 2668, Asia Minor, south coast: Mersina roadstead, 2*s*. 1227, North America, east coast: Boston bay and approaches, 3*s*. 1516, North America, east coast: Boston harbour, 3*s*. 2890, North America, east coast: Nantucket shoals to Block island, 3*s*. 1802, South America, north-east coast: Surinam to Cabo do Norte, 2*s*. 891, South America, east coast: Pernambuco to Maceio, 4*s*. 645, South America, west coast: Plans on the coast of Peru, 3*s*. 1849, Africa, north coast: Simons bay, 3*s*. 756, Bay of Bengal: Entrance of the Devi river, 3*s*. 2684, New Zealand: Cook strait anchorages, 3*s*.

Alaska. **U.S. Coast and Geodetic Survey.**

General chart of Alaska. Scale 1:3,600,000 or 1 inch to 56·8 stat. miles. Washington: U.S. Coast and Geodetic Survey, 1909.

Atlantic, North. **U.S. Weather Bureau.**

Meteorological chart of the North Atlantic Ocean, January, 1911. Washington: Department of Agriculture, U.S. Weather Bureau, 1911. *Presented by the U.S. Weather Bureau.*

Indian Ocean. **U.S. Weather Bureau.**

Meteorological chart of the Indian Ocean, January, 1911. Washington: Department of Agriculture, U.S. Weather Bureau, 1911. *Presented by the U.S. Weather Bureau.*

Pacific, North. **U.S. Weather Bureau.**

Meteorological chart of the Indian Ocean, January, 1911. Washington: Department of Agriculture, U.S. Weather Bureau, 1911. *Presented by the U.S. Weather Bureau.*

PHOTOGRAPHS.

Dutch East Indies. **Garrett.**

One hundred and seventeen photographs of Borneo and Java, Dutch East Indies, taken by F. R. H. Garrett, Esq., 1909. *Presented by F. R. H. Garrett, Esq.*

The types of natives in this set are specially good and clear. There are also some good views of scenery and other subjects.

Borneo: (1) **Banjermassin**; (2) S. Martapura, Banjermassin; (3) Prau in the S. Martapura; (4) S. Kivin; (5 and 6) Sampit; (7–9) Dyak and Banjarese at Sampit; (10) Kita Bahru, P. Laut; (11 and 12) G. Tangkuban Prahu; (13) Tjilakak at Wanajasa; (14) Effect of erosion at Balik Papan; (15–32) Banjarese; (33) Banjarese man and child; (34–41) Bulongan; (42–45) Bulongan, Orang Mekolit; (46–48) Bulongan and Bugis; (49–73) Sundanese; (74–88) Javanese; (89–95) Malay and Sundanese; (96 and 97) Malay and Javanese; (98 and 99) Bulongan and Javanese; (100 and 101) Sumatran Malay and Banjarese; (102 and 103) Sundanese and Javanese; (104–113) Natives of the Dutch East Indies.—**Java**: (114) G. Salak from Buitenzorg; (115) Victoria Regia in garden at Buitenzorg; (116 and 117) Waterspout in the Straits of Malacca.

Egypt. **Cutlack.**

Forty-eight photographs of Egypt, taken by W. Cutlack, Esq., J.P., 1910. *Presented by W. Cutlack, Esq., J.P.*

A carefully arranged set of small photographs mounted in an album and clearly titled.

(1) The Sphinx; (2) The Great Pyramid; (3) The Cairo Museum; (4) Amenhetep III. and wife Tii, Cairo Museum; (5) The sitting scribe, Cairo Museum; (6) Sheikh Ee-Beled, Cairo Museum; (7) Natives, Cairo; (8) Native turner using a fiddle bow; (9) Mosque at Cairo; (10) A funeral, Cairo; (11) The tombs of the Caliphs; (12) A Shadouf; (13) Desert party near Memphis; (14) Nile boat and raft at Luxor; (15) Karnak temple; (16) Avenue of rams' headed sphinxes, Karnak; (17) Temple of Ramses III., Karnak; (18) Vocal statue of Memnon; (19 and 20) Ostriches at the farm at Heliopolis; (21) Native group

at On; (22) Minaret tower at Cairo; (23 and 28) Hypostyle Hall, Karnak; (24) The Pylon, Luxor temple; (25) Market scene at Luxor; (26) Hay and fodder market, Luxor; (27) Temple gate, Luxor; (29) Nile boat; (30) The barrage dam; (31) Flock of goats, Memphis; (32) Statue of Ramses II. at Memphis; (33) Sir Petrie Flinders excavating at Memphis; (34) Ploughing with oxen, Memphis; (35) Water-seller, Luxor market; (36) Native boys, Karnak; (37 and 38) Luxor market; (39) Temple of Edfu; (40, 43, and 46) Temple of Kurna; (41) A Sakkya; (42) Mock Dervish dance, Giza; (44) Said Tanins, dragoman, Luxor; (45) Oldest obelisk at On; (47) Street in Port Said; (48) Sugar-cane stall, Port Said.

New Zealand and Samoa Islands.

Fifteen photographs of New Zealand and the Samoa islands. *Presented by H. M. Hayward, Esq.*

Good and clean photographs measuring 6 inches by 8 inches. Those of the White Terraces before and after the eruption of 1886, and of Tarawera, are specially interesting.

(1) The White Terrace, Rotomahana, before the eruption of June, 1886; (2) The White Terrace in eruption; (3) The White Terrace and Rotomahana, 1880; (4) Site of Rotomahana and the White Terrace after eruption of June, 1886; (5) Tarawera after the eruption; (6) Waimangu geyser in action; (7) Steam-cloud from Waimangu; (8) Waimangu crater; (9) Ravine, Tarawera; (10) Ashfields and craters, Tarawera; (11) Old Mission Church at Wairoa after the eruption, 1886; (12) Ruins of old church at Wairoa; (13) Village of Wairoa.—**Samoa Islands**: (14) Lavafields, Savaii; (15) Lava flowing from volcano on Savaii.

Persia. **Sykes.**

Sixty-seven photographs of North-East Persia taken by Major P. M. Sykes, C.M.G. *Presented by Major P. M. Sykes, C.M.G.*

These interesting photographs were taken by Major Sykes during his recent journeys in Persia, an account of which will be found in the present number of the *Geographical Journal*. As will be seen by the titles, they are of various subjects, but are thoroughly characteristic of the country.

(1 and 2) In the Kuh-i-Hezar range; (3) The Kuh-i-Hezar range; (4) The Mil-i-Radkán; (5) Sorting turquoises; (6) Shahr-i-Bilkiz (ancient city of Isfarayin); (7) The tomb of the chief of Bujnurd; (8) Palace at Bujnurd; (9) Gardens at Bujnurd; (10) Kurdish sowars; (11) Hills west of Bujnurd; (12) Karabil west of Bujnurd; (13) In the hills to the west of Bujnurd; (14) *Ovis vignei arcal* 38, shot to east of Gurgan defile; (15) Kara Tikan at top of Gurgan defile; (16) *Cervus elephas maral*, shot near the Gurgan defile; (17) Eastern edge of the Gurgan forest; (18 and 19) In the Gurgan defile; (20) Goklan chief with two sons; (21 and 22) Goklan Turkoman; (23) Women of the Gurgan valley; (24 and 25) A homestead in the Gurgan valley; (26) Reed brakes in the Gurgan valley; (27) A Goklan sowar; (28) Yamut Turkoman ploughing; (29) In the Gurgan valley; (30) Kara Maran (site of Dareion?); (31) The "Sadd-i-Sikandar" or Alexander's Barrier; (32) The Gunbad-i-Kabus; (33) An Astrabad graveyard; (34) The Palace, Astrabad; (35) The Kuzluk pass, looking north; (36) The summit of the Elburz with Shah Kuh in front; (37) The "Shaking Minaret" of Bostam; (38) Bostam; (39) The "Kashana" of Bostam; (40) The Caravanserai at Miandasht; (41) Mil-i-Khusrugird (ancient Sabzawar); (42) Humble wayfarers in Khorasan; (43) Tombstone of Sheikh Attar; (44) Tomb of Sheikh Attar; (45) Shrine of Shahzada Mahruk; (46) Kadamgah from the east; (47) Falconers at Bujnurd; (48) The Jaghark valley; (49) Jaghark; (50) Threshing out the corn; (51) The chief of the Ismailis; (52) Kadamgah; (53) Ruins of ancient Nishapur; (54) Ploughing in the Nishapur valley; (55) Sacred tree at Katkan; (56) Kala-i-atish-Gah; (57) The "Mil-i-Kishmar; (58 and 59) Ancient Turshiz; (60) An oriental plane at Askand; (61) Turbat-i-Heideri; (62) A Turkoman sowar; (63) A typical peasant proprietor; (64) A carpet-seller at Turbat-i-Heideri; (65) A Persian mason; (66) The Great Bustard; (67) A Persian Dervish.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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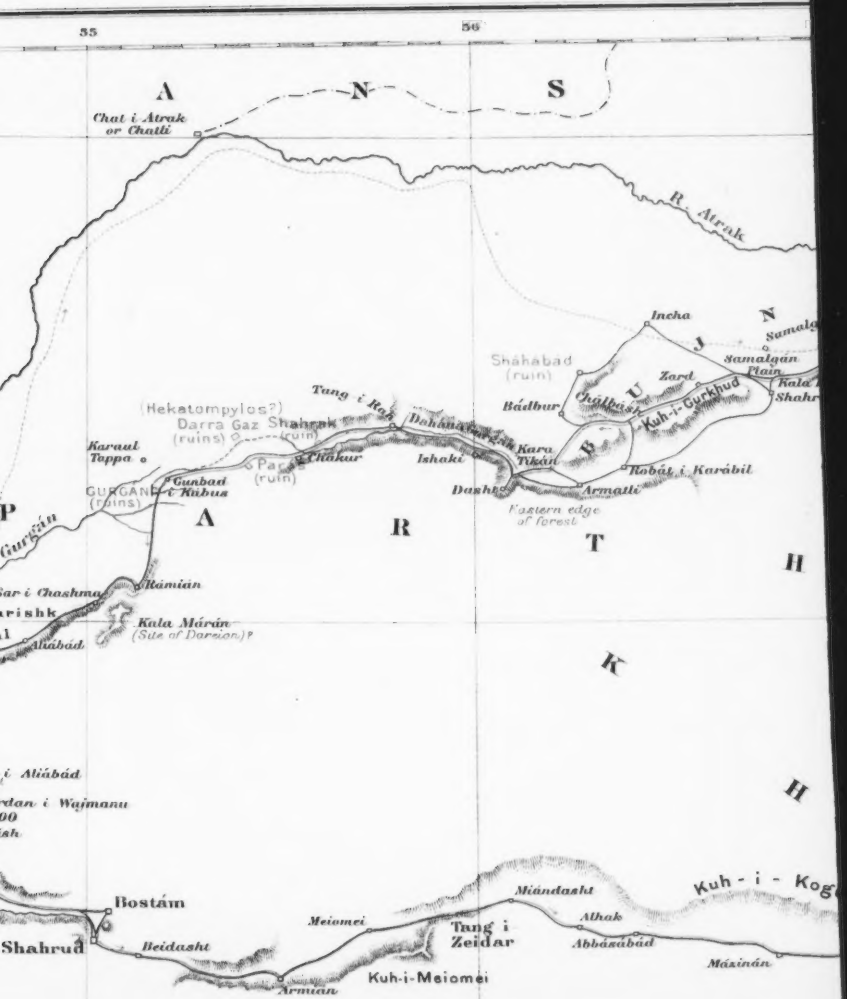
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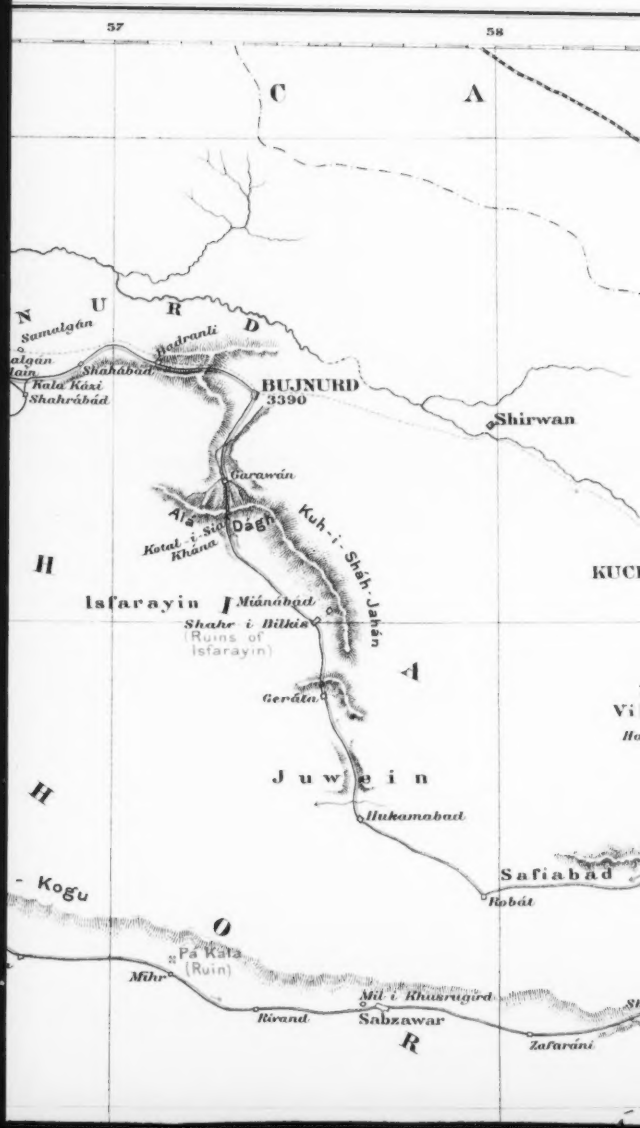
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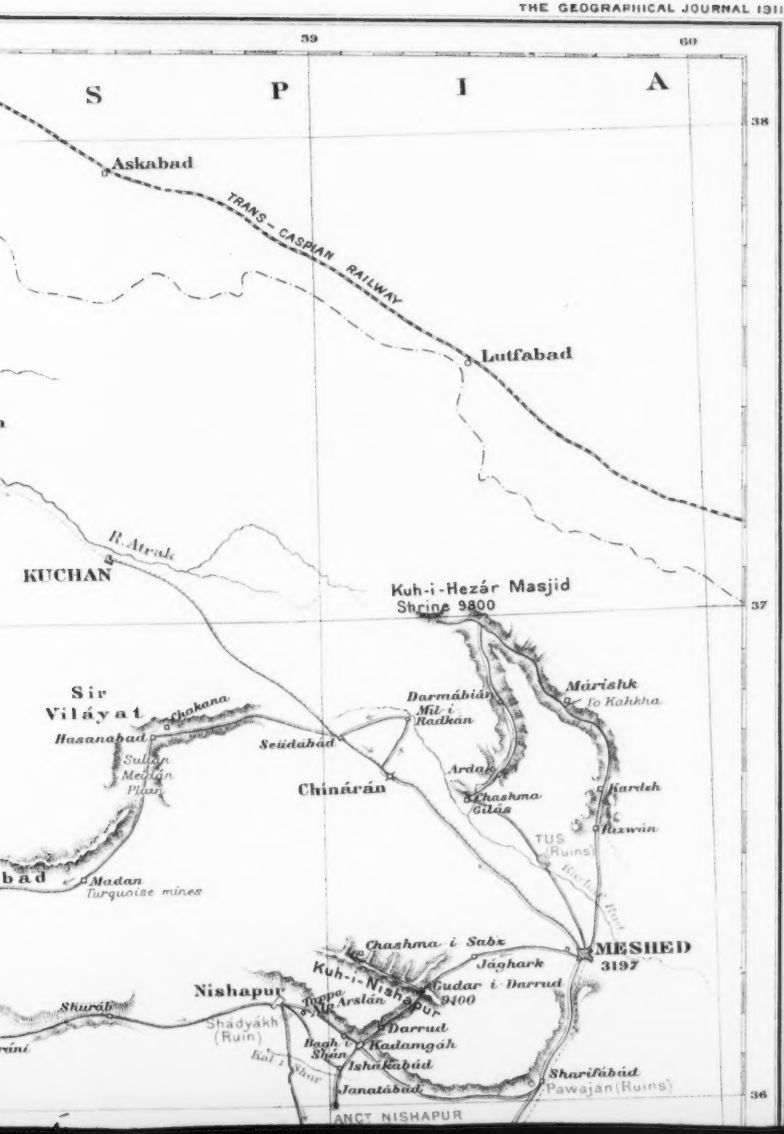


NORTH-EAST PERSIA

SKETCH MAP

to illustrate the journeys of

MAJOR P. M. SYKES, C.M.G.

H.M. Consul General in Khorásán.

Nat. Scale 1 : 1,500,000 or 1 Inch = 23·67 Stat. Miles.

10 5 0 10 20 30 40 50

Statute Miles.

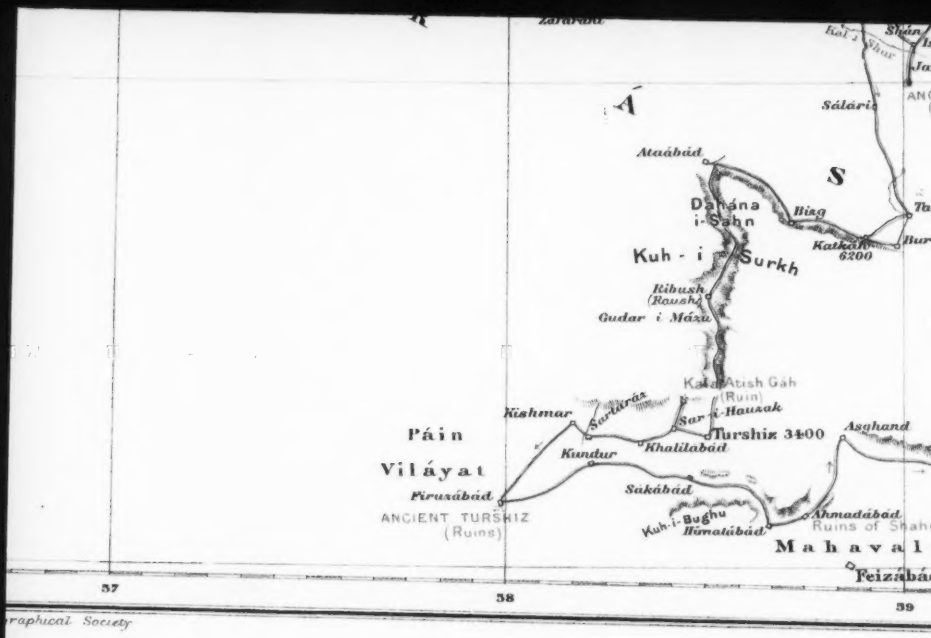
Reference to Routes.

1st Journey 1893. ----------

6th ,, 1908-9. _____

Heights in feet.

Published by the Royal Geographical Society



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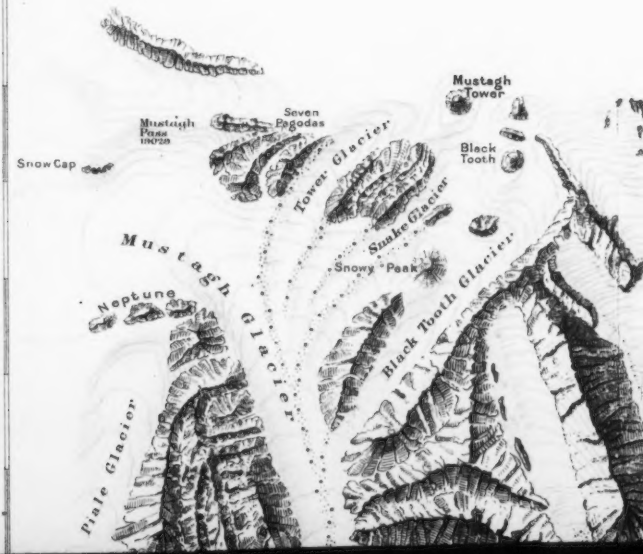

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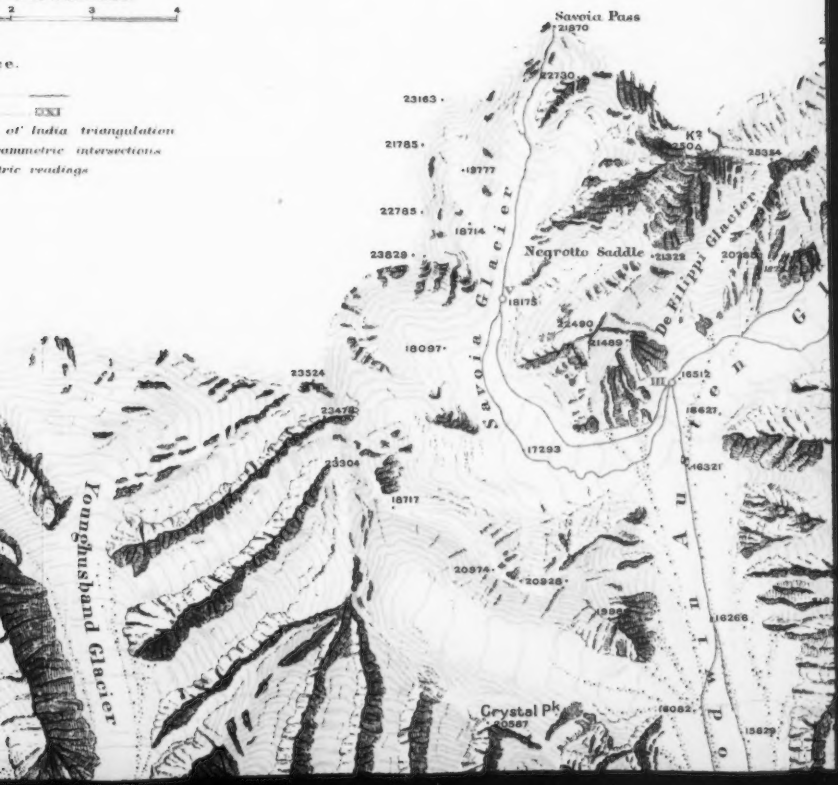

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Note.
This map is based on theodolite and photogramm
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supplemented by the survey of Sir Martin Conway 1892
adjusted to the Survey of India positions

RAM HIMALAYAS.
Abruzzi.

APHICAL JOURNAL 1911

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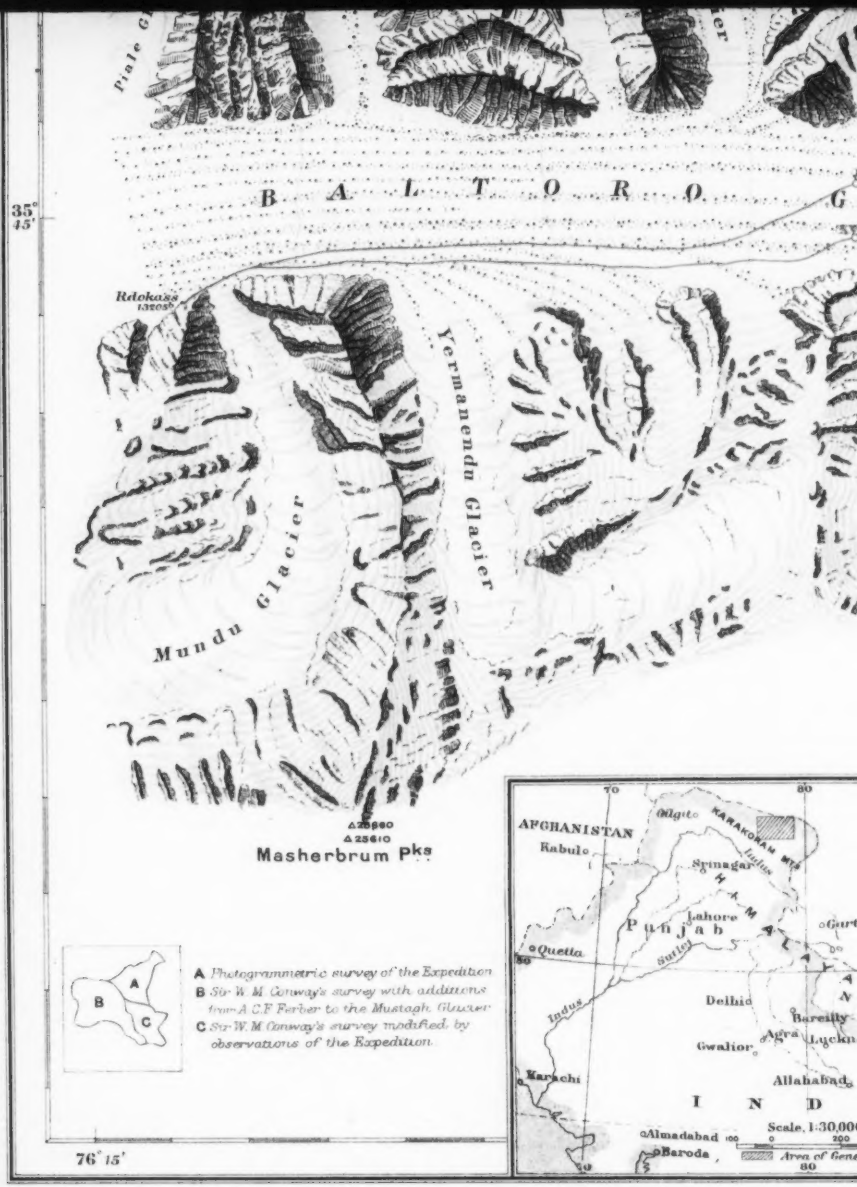
B A L T O R O
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Mundu Glacier
Masherbrum Pks
35° 15'
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A Photogrammetric survey of the Expedition
B Sir W. M. Conway's survey with additions from A. C. F. Ferber to the Mustagh Glacier
C Sir W. M. Conway's survey modified by observations of the Expedition
AFGHANISTAN
Kabul
Srinagar
Punjab
Lahore
Quetta
Delhi
Gwalior
Karachi
Allahabad
Ahmadabad
Baroda
Scale, 1:30,000

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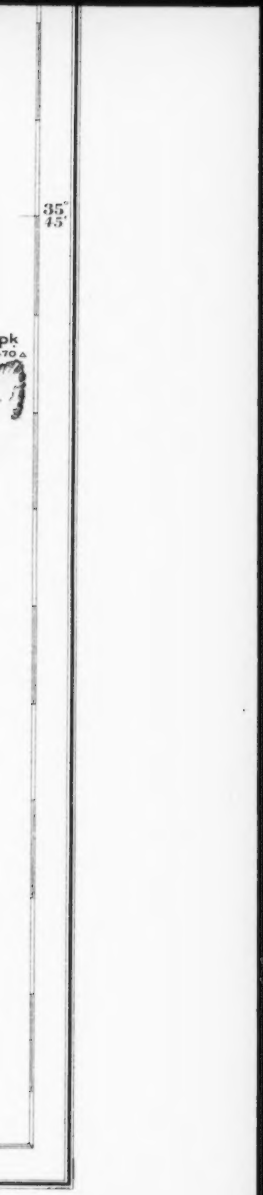
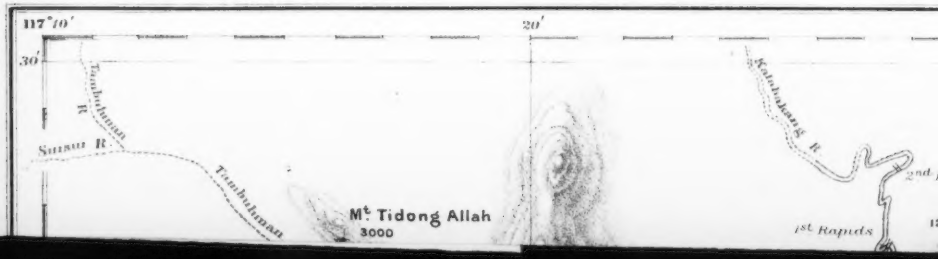
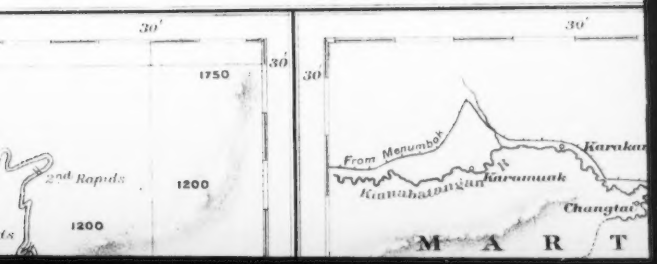
Gasherbrum Pks
26090
26360
Hidden pk
26470
Golden
Throne
Kondus Saddle
Chogolisa Saddle
Bride Pk
25600b
23456b
21667b
20777b
19091b
17952b
22139
24018
22562
21621
18788
22155
21207
20577
16637
16532
16486
16594
20833
20440
15820
18153
15738
15715
16063
20876
17454
35'
45'
76°35'


35°
45'
pk

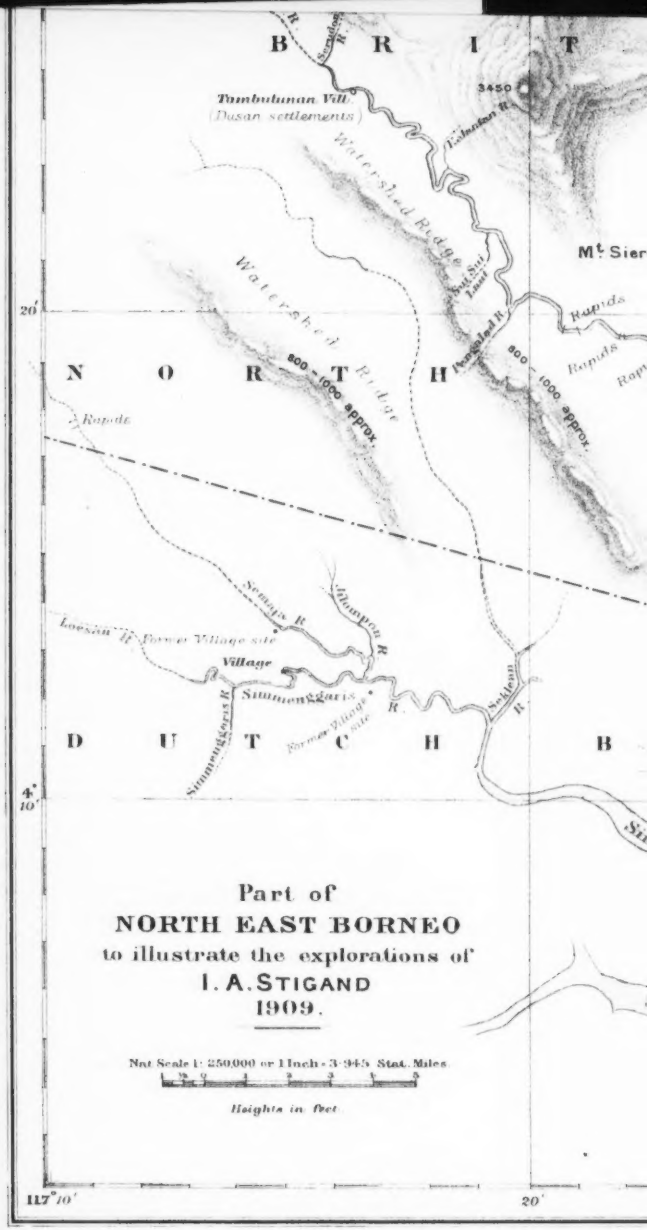

117°40′
20′
30′
Tambalanan R
Sunsu R
Tambalanan
Mt. Tidong Allah
3000
Kalabakang R
2nd
1st Rapids

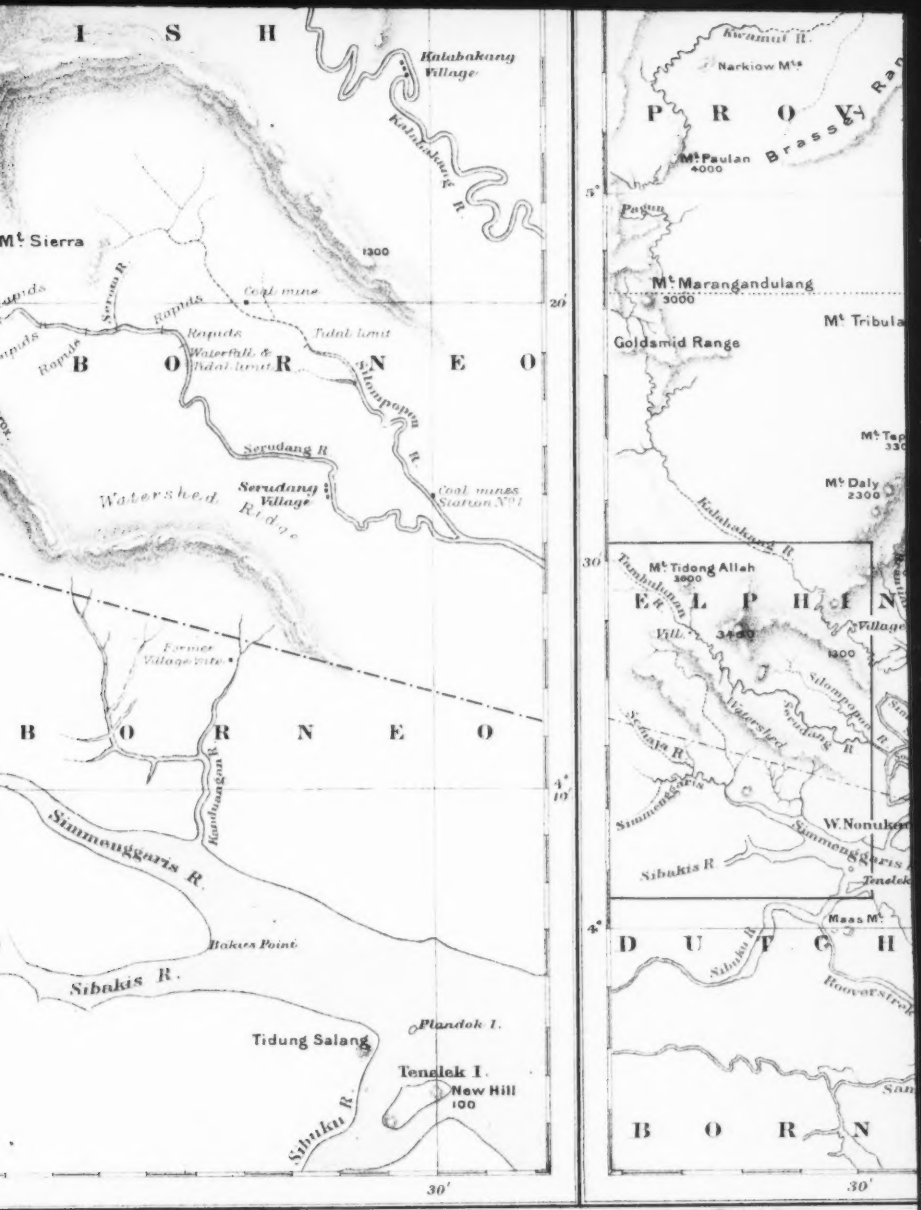

30'
30'
1750
2nd Rapids
1200
1200
30'
30
From Menumbok
Karakan
Kamahaimpan
Kuraunuak
Changtar
M A R T

30'
118°
30'
Notch Hill
803
Kinnabalugan R.
Kuyah R.
Tampasuk R.
Sugamo R.
Karakara
Changtai
Marundom
Telegraph to Sandakan
MYBURGH PROVIN
RTIN

N.E. BORNEO
STIGAND

EOGRAPHICAL JOURNAL 1911.


B R I T
Tambulunan Vill.
(Dusan settlements)
3450
Watershed Ridge
Watershed Ridge
Mt. Sier
Rapids
Rapids
800 - 1000 approx.
800 - 1000 approx.
N O R T H
Rapids
Sempys R.
Bampoa R.
Lawsian R.
Former Village site
Village
Simmenggaris R.
Former Village site
Simmenggaris R.
Sekikap R.
D U T C H B
Part of
NORTH EAST BORNEO
to illustrate the explorations of
I. A. STIGAND
1909.
Nat Scale 1: 250,000 or 1 Inch = 3·945 Stat. Miles
Heights in feet
117° 10'
20'
20'
4° 10'



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M A Y N E
Pungeran R.
I N C E
Segama R.
Quoin Hills
Barrier Falls
Mt Beeston 2830
Mt Silam 2920
Silam
Lamak B.
Skertchley Pt
Mt Tribulation 4200
Mt Ambun 3300
Mt Skertchley 1930
Mt Madai 1440
Mt Tapei 3300
1800
Mt Daly 2300
2200
1800
Mt Magsyn 1525
Mt Stewart 1555
Mt Hawes 1355
Mt Magdalena 4420
Pyramid H. 2070
2500
Mt Lucas 1970
I N S T
Lion Mt 1170
O N E
P R O V
Village
Table Mt 1980
Mt Brodie
1300
1405
Mt Andressy 2200
450
Saddle
Saddle R.
Silampongan R.
Simuadhan Saddle
COWIE HARBOUR
Mt Kukusan
Tanjong Batu
Tawau
600
Batu Tenagat
450
Mt Antoinette 1550
Sauna Hd
E. Corner
Sebattek I.
800
S I B
W. Nonukan
Sibaris R.
Tendek I.
East Nonukan
830
890
Stone Corner
S. Corner
S T L U
Maas Mt
G H
S. Corner
Bouvert Strek or Boekat R.
Boekat I.
Espada I.
Scale 1:1,000,000 or
Sambakong R.
Mt Sambakong
N E O
Height
30'
118°

E P R O V I N C E
Mt Cook
1680
Mt Bagahak
2740
Bagahak Range
Lahar Datu
Saccar I.
Silam Hr
Darvel Peninsula
Kennedy Bay
D A R V E L B A Y
Tabanawan I.
Timbu Mata I.
Mt Cook
Mt Hewett
1355
Gaya I.
Sabankat I.
Langas I.
Mt Singalong
2080
Bum Bum I.
Mt Pock
1860
Omadal I.
Nuzatonga I.
Saddle Hill
Kungong I.
Mabul I.
Kapalai I.
B U K U O R
L U C I A B A Y
5°
4°
30'
SARAWAK
DUTCH
BORNEO
1,000,000 or 1 Inch = 15·78 Stat. Miles
Heights in feet.